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## Williams' Inertia Instrument.

This instrument was briefly referred to in a communication from Mr. Williams, published in a previous issue of the AMERICAN MACHINIST, and afterwards commendably noticed by J. C. Hoadley, and by others. The instrument is patented, and is manufactured by the Crosby Steam Gage and valve Company, Boston, Mass. The following description of this instrument is by the inventor, E. F. Williams, of Philadelphia:

Charles T. Porter, the eminent engineer, saw, years ago, the importance of the subject of inertia in the steam engine, and was the first to investigate it, giving to the world the benefit of his calculations. But, like other great subjects, this one will require years for its investigation, and many years may yet be required for that refinement of knowledge which will subject the mighty inertia forces of the reciprocating parts of an engine to the will of man, making them in all cases conducive, instead of in many cases being destructive, to successful practice at high speeds. The inertia instrument is intended as an aid in this particular branch of steam engineering. As its name implies, it is designed to measure the forces of inertia; not only in amount but in distribution also; and the revelations of this instrument have shown its competency in giving the amount and direction of the inertia forces at all points in the stroke within a practical limit of accuracy. It is not claimed to be absolutely correct. Such a thing as absolute accuracy is rarely, if ever, attained by any instrument for any purpose. Steam engine indicators are inaccurate on account of expansion of parts by heat, friction and inertia of their moving parts, etc. Yet we find them sufficiently accurate for practical purposes, and they have become indispensable to engineering practice.

The inertia instrument does not measure the actual inertia forces of the reciprocating parts themselves, but that force developed by a known weight moving with the cross-head, as though it were a part of it, forming what might be called the inertia exponent of the engine.

A view of the instrument, as attached to the cross-head, is shown in Fig. 1.

The stud $j$, screwed into the cross-head, holds the frame $P$, at that end, while a smaller stud $r$, keeps it from turning about the stud $j$. In this manner it is secured to the cross-head and made to travel with it. The stud $j$ is used also for a pivot for the arm $B$, which carries the paper arc $b$, forward and backward, giving motion coincident with the motion of the piston to the paper placed upon it.

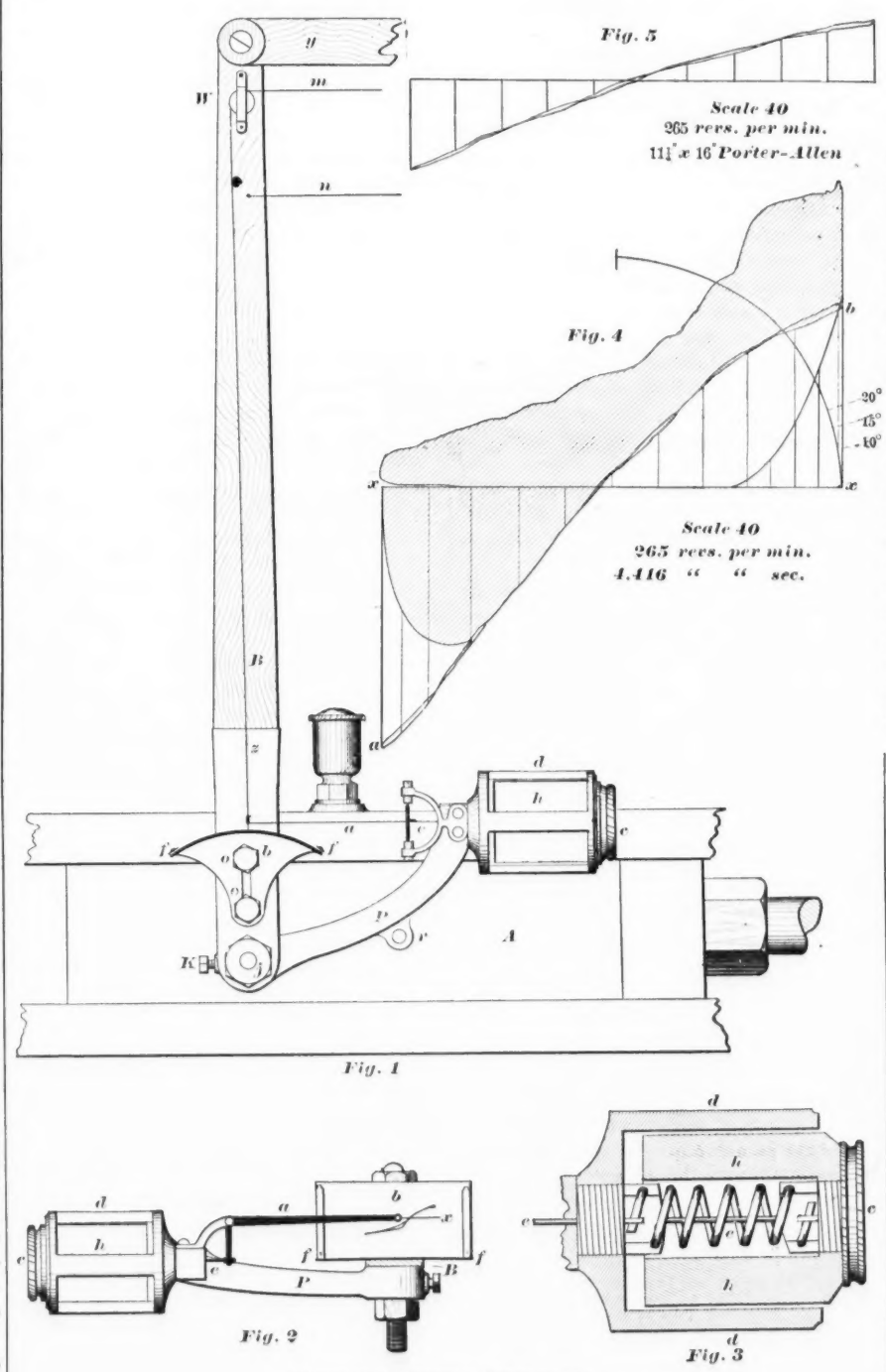
The inertia diagram is drawn upon this paper. A plan of the paper arc is shown in Fig. 2.

Within the case $d$, is the weight $h$. The inertia of this weight is what the diagram represents. The movement of this weight within its case is communicated to a marking point by means of the marking lever $a$, which is a bent lever, and attaches to the weight by the rod $e$, as represented in Fig. 2. The movement of the weight is opposed by a spring of known force, as shown in the sectional view, Fig. 3.

In order to prevent friction the weight moves along on steel rollers (not represented). The paper arc $b$, is arranged so it may be moved along the vibrating arms about $\frac{1}{8}''$, in order to bring it in contact with, or move it away from, the marking point. The cord $m$, is attached to the arc, by which it (the arc) may be lifted up or let down at will, while the engine is in motion.

The upper end of the vibrating lever is prevented from traveling with the instrument by the lath $y$, one end of which is made fast to some stationary object in line with the instrument. The cord $n$, is for indicator attachment, and gives a reasonably correct movement to the paper drum.

While the engine is at rest the paper is placed upon the arc, then the lever is moved backward and forward by hand, and by bringing the paper in contact with the marking point the neutral line ($x$ Fig. 2) is drawn. Then, when the engine is running under the desired conditions, the paper is drawn up in contact with the marking point by the cord $m$, and the diagram is drawn.




WILLIAMS' INERTIA INSTRUMENT.

I do not believe a further description is necessary.

Fig. 5 is an inertia diagram from an exceptionally smooth running engine, at the Boston post-office, and the diagram is, in consequence, an exceptionally good one. As I stated in a former communication, no engine moves mathematically correct. If it were so, there would not be the least jar; its action would be perfectly smooth. The more the engine departs from the mathematically correct movement, the more noisy and unsatisfactory it will be under same speed.

As near as I am able to judge, from my limited experience with the instrument, its diagrams are an unerring index of the smoothness with which the engine makes its motions. The farther the diagram departs from the mathematical curve at any point—the more serrated or irregular its form—the greater is the tendency of the engine to pound.

Since it is desirable to have the diagrams at all speeds somewhere near of the same size, it is necessary to change the scale for different speeds. This is done by changing the weights and springs.

An 80 lb. spring, with 1 lb. weight, makes the scale 40. Likewise,

| | | | | |
|---|---|---|---|---|
| 80 lb. | spring, | 2 lb. | weight, | scale 20 |
| 40 lb. | " | 1 lb. | " | " 20 |
| 40 lb. | " | 2 lb. | " | " 10 |
| 20 lb. | " | 1 lb. | " | " 10 |
| 20 lb. | " | 2 lb. | " | " 5 |
| 10 lb. | " | 1 lb. | " | " 5 |
| 10 lb. | " | 2 lb. | " | " 2.5 |

The scale is found as follows: The force required to compress or extend an 80 lb. indicator spring $\frac{1}{4}''$, causing a pencil movement of one inch, is 80 lbs. per square inch, and as the area of the indicator piston is $\frac{1}{2}''$, the actual force is 40 pounds. Now, if the 80 lb. indicator spring be placed in the inertia instrument, and a 2 lb. weight attached to it, whenever the inertia force of that weight equals 40 pounds the spring will be compressed or extended, as the case may be, $\frac{1}{4}''$, causing a pencil movement of 1" (the multiplication being 4 : 1) from the neutral line, so that a pencil movement of one inch would represent a force of 40 pounds; and as the weight is 2 pounds, the actual force represented would be twenty times the weight of the moving body, and the scale would be 20, meaning that a pencil movement of one inch from the neutral line represents an inertia force equaling twenty times the weight of the body indicated, or the reciprocating parts of the engine with which it is moving.

If the actual weight of the reciprocating parts were 1,000 pounds, the inertia force represented by a rise of the pencil of one inch from the neutral line would be 20,000 pounds; and every one-twentieth of an inch would represent 1,000 pounds, or the weight of the parts. Divide this force by the area of the piston and you have the inertia force per square inch of piston area. Then it is ready to compare with steam forces, which are always reckoned per square inch of piston area also.

The scale noted on all future inertia diagrams will mean in terms of weight of reciprocating parts, scale 40, scale 20, or as it may be; the number of the scale indicating that fraction of an inch which represents a force equaling the bodies' own weight.

When the weight ratio to area of piston is known the process may be shortened by simply changing the scale according to that ratio. For example: If the scale were 20, and the weight of the reciprocating parts was three pounds per square inch of piston, then change the scale to 60, and it would represent inertia forces per square inch of piston area. Then an indicator diagram of 60 scale would be ready for immediate comparison. In the engine from which diagram Fig. 5 was taken the weight ratio was 3, and the scale was 40, so in transposing it upon the 40 scale indicator card, Fig. 4, it was necessary to extend its vertical dimensions three times. Fig. 4. shows how the distribution of steam forces were modified before reaching the crank pin by the intervention of inertia in the reciprocating parts. The shaded portion measured vertically represents the true distribution of forces upon the crank pin during the backward stroke.

## Best Method and Material for Lubricating Valves and Cylinders.

REPORT OF A COMMITTEE OF THE AMERICAN RAILWAY MASTER MECHANICS' ASSOCIATION.

*Gentlemen*,—Your committee on the best method and material for lubricating valves and cylinders prepared a circular which was distributed by the secretary, with the view of obtaining in brief and comprehensive form as much information as possible from different roads throughout the country, to enable them to make a report which would be of value to the association.

The following questions were asked:

1. What kind of lubricant do you use on valves and cylinders?
2. Have you made any experiments with other kinds of lubricants? If so, please state results obtained.
3. How is the lubricant applied—by self-feeders, cup on steam chest, or through pipes from cab? Please describe the device you are using. If self-feeding cup, where is the best location?
4. Have you made any experiments with self-oilers? If so please describe the different devices, and give results of experiments.
5. What results have you obtained in the wear of valves, piston packing and glands with the lubricant you are now using compared with others you have tried?
7. What, in your opinion, is the best method of applying the lubricant to cylinders?
8. If you are using a compound that is made of several lubricants, please give proportions?

In answer to the above questions, please do not confine yourself to the questions, but give any facts or exact data you may have bearing on the subject.

Replies were received from twenty-six different roads, without, however, eliciting much information beyond a general expression of opinion in a general way as to the merits of different lubricants used, and the varying methods of their application. The statistics showing comparative results as to mileage and economy of sight-feeding automatic lubricators, and the practice of applying the lubricant at intervals by hand, which it was expected would be furnished to the questions asked, were not received; but, without having sufficient evidence to enable your committee to come to any definite conclusion, there is reason to believe some light has been obtained that will indicate the direction in which improvement is to be anticipated.

Of the twenty-six roads reporting, eight use tallow as a lubricant, while eighteen use valve oil. Twenty-one have made experiments with lubricants; five have not made experiments. Twelve apply lubricant exclusively through pipes leading from cab to steam chests, feeding at intervals by hand; fourteen, in connection with pipes leading from cab to chests and intermittent hand-feed, use sight feed-cups in cab, nine of which use, in addition, self-feeding cups located on chests. Seventeen have made experiments with self-oilers; five have made no experiments; four not stated.

The following tabulated statement shows lowest and highest mileage to a pound of tallow or pint of oil, used for valves and cylinders in passenger service and in freight service, as obtained in ordinary practice, and the different experiments made:

| Class of Service. | Lubricant. | METHOD APPLIED. | Lowest Mileage to a pound of Tallow or pint of Oil. | Highest Mileage to a pound of Tallow or pint of Oil. |
|---|---|---|---|---|
| Passenger. | Tallow . . | Pipes from cab, intermittent hand-feed. | 55 | 60 |
| | | Self-feeding cups on chests. | 52 | 100 |
| Freight... | Tallow ... | Pipes from cab, intermittent hand-feed. | 26 | 40 |
| | | Self-feeding cups on chests. | 18 | 31 |
| Passenger. | Valve oil.. | Pipes from cab, intermittent hand-feed. | 43 | 114 |
| | | Sight feed in cab through pipes to chests | 59 | 206 |
| Freight... | Valve oil.. | Pipes from cab, intermittent hand-feed. | 30 | 85 |
| | | Self-feeders on chests. | 35 | 59 |
| | | Sight feed in cab to dry pipes. | 48 | 100 |
| | | Sight feed in cab through pipes to chests | 55 | 125 |

As to the effect of tallow on wear of valves, piston packing and glands, four have obtained good results, six have had bad results, and ten have not stated their experience.

With valve oil, seventeen have had good results; nine have given no information.

None of the reports received mention any bad effects resulting from the use of valve oil.

Many different opinions are expressed as to the best method of applying lubricant to cylinders. Of the twenty-six replies received to the circular, nine have not expressed any opinion on this point. Of the remaining seventeen, eight prefer sight feed-cup in cab leading through pipes to the steam chests; six consider pipes to chests, feeding at intervals by hand, the best; two favor sight feed-cup in cab feeding directly to dry pipes; and one has obtained best results with self-feeding cup directly on chests.

With the exception of one road, the valve oils used are those brands purchased in open market, and generally known throughout the country. The valve oil used by the Ohio and Mississippi is one of their own manufacture, consisting of one part tallow and two parts Virginia oil, costing thirty cents per gallon, which gives good results as to wear of valves, piston packing, etc., with an average of sixty-seven miles to a pint for passenger and freight service, the oil being applied at intervals by hand through pipes leading from cab to steam chests.

The objection generally advanced against the use of tallow is its corrosive effect upon the surfaces of the valves, steam chests and cylinders exposed to its action, resulting, probably, from acids and adulterations found in refined tallow of ordinary grades. It has been observed by your committee that the roads on which good results have been obtained from the use of tallow are those in the Southern States, which are liable to secure an abundant supply of pure country tallow that has not been subjected to the manipulation of a refining process. On one road in North Carolina, where tallow had been used exclusively, the original steam chests and cylinders of an engine which has been continuously in service for twenty-eight years present no evidence whatever from corrosive action, and are still in good condition, other engines on same road being in equally good condition.

Were it possible to procure tallow in unlimited quantities, there would be little occasion for a discussion of this subject; but as few roads are thus fortunately situated, the lubricant best adapted as a substitute for tallow becomes a matter of importance.

The results obtained from the use of lard oil, aside from the closing up of exhaust openings by the accumulation of gum in the nozzles, are, as a rule, satisfactory; but its cost is such that a cheaper oil is more desirable.

Of the many kinds of oil technically known as "valve" or "cylinder" oils, which are at present offered in the market, your committee are not prepared to express an opinion as to which may be deemed the best, finding among those who have used them many advocates in favor of each different brand.

As to these oils, it may be said that they are the result of study and experiment on part of the manufacturers to produce a lubricant combining all the requisite qualities at moderate cost; and from the extent to which such oils have been introduced, the deduction is a reasonable one that their efforts have been successful.

With regard to the best method of applying lubricant to cylinders, your committee find a variety of opinions, due chiefly to varying conditions on different roads.

It is generally admitted that the old practice of applying the lubricant at intervals by hand through ordinary cups, located directly on steam chests, is a crude and wasteful method, unsatisfactory in its results, and on most roads has been abandoned.

The next step was the location of the oil cups in cab connecting with pipes leading to the steam chests. This arrangement enables the engineer to exercise direct supervision on the amount of oil used, and overcomes many of the objections to outside oiling. On many roads it is considered the best method of applying the lubricant; but your committee has observed that where such opinion is held there has been little or no experience with the more recently automatic improved oilers.

It may be stated that the objection to all methods of hand-feed rests in the fact that, while an engine is in motion, reliance is necessarily placed on the care and judgment of the engine-man to feed at proper intervals the least amount of oil required to maintain thorough lubrication. They must not neglect this duty, and to obtain the best results they must possess a sufficient degree of intelligence to use only the proper quantity of oil each time the feeding is done.

The introduction, some years ago, of the automatic cup or self-oiler, located on the steam chests, and feeding the lubricant continuously, was an improvement, which, however, did not meet all the requirements. Depending for its action on the condensation of steam, and being exposed directly to the effect of changes in temperature, it was found that in extreme cold weather the water within the cup would freeze and stop its operation. Many expedients to overcome this trouble were resorted to, but without much success; and, in consequence of its unreliability in cold climates, this cup has, in a great manner, passed out of use. In the South, where this difficulty is not experienced, the cup is still considered on many roads well adapted for the purpose.

The latest improvement in the method of applying lubricant to cylinders is found in the sight feed automatic cup located in cab, and feeding oil either directly to dry pipe, or through small pipes to the steam chests. The action of this cup is continuous; the oil contained within it being displaced by condensation of steam taken from the boiler. The feed, in plain sight, admits of perfect regulation, and when set to the proper amount, the cup continues its operation automatically, drop after drop passing from it until the supply of oil is exhausted.

Your committee have not received statistical information concerning the performance of the sight feed cup on other roads to an extent sufficient to warrant a statement as to its economy in general use; but from experiments made by the chairman it was found that the sight feed cup gave in passenger service 80 per cent. better mileage, and in freight service 47 per cent. better mileage, than the best results obtained by hand-feed through pipes from cab leading to chests.

The opinion held by a few members of the association that the feeding tube from automatic cup located in cab should lead direct to dry pipe does not find favor with your committee; it being considered more desirable that the lubricant should be supplied in certain quantities to each valve and cylinder rather than to depend upon the chances of its taking that course at the junction of the dry pipe with the steam pipes.

In conclusion, your committee would give it as their opinion that the leading brands of valve oil are well adapted for the lubrication of valves and cylinders, and are at the present time the best lubricant available for the purpose in quantities sufficient for general use.

The best method of applying lubricant to valves and cylinders in their opinion is the automatic sight feed cup located in cab and feeding through pipes to steam chest.

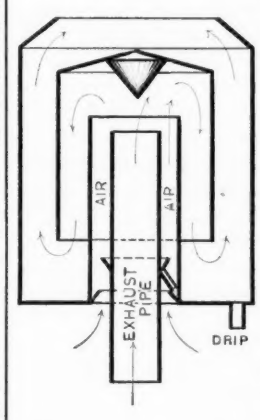
Respectfully submitted,

H. Schlacks,
J. M. Boon,
H. Middleton,
Committee.

## Campbell's Exhaust Condenser, or Condenser Head for Non-Condensing Engines.

The water from the exhaust pipe of a non-condensing steam engine is in the majority of instances a nuisance, and frequently results in damage by destroying the covering of the roofs of buildings, and other property. Hence its avoidance is almost always advisable, and particularly so when the means taken to do so result in economy through reduction of back pressure.

The engraving represents a device recently introduced for this purpose. It will be seen that the head is attached to the end of the exhaust pipe, and that it is provided with air passages so arranged that air will be drawn into the chamber by induction, and mingling with the steam will condense a portion of the latter, and at the same time cool the walls of the chamber. The arrows show the direction of the steam and air as they enter the chamber, as well as the direction they must take in leaving, the water resulting from condensation settling to the bottom of the chamber and passing out of the drip pipe. By this means the steam is deprived of moisture, that which is not condensed escaping from the head quite dry and nearly noiselessly. At the same time the quantity of steam that is condensed results in reducing back pressure on the piston, while the water from the drip may be returned and used for any desired purpose.




Quite a large number of these condensers are in use, and we are informed that they are giving entire satisfaction. The New York agents are Berton & Nickel, 422 East 23d st.: general agent, J. L. Hornig, 7 Mandeville avenue, Jersey City, N. J.

## What are Raw Materials?

From the Boston *Commercial Bulletin*:

Discussions upon tariff matters would be simplified if both sides could unite upon a definition of the term "raw materials." But this is apparently impossible because of the difficulty of deciding just how much human labor shall be permitted to be expended in the production of an article of merchandise before it ceases to be considered a "raw material." It we remember rightly, Mr. Robert Bleakie, of Hyde Park, Mass., thinks woolen and worsted yarns are raw materials because he uses them in weaving cloth, and he believes they ought to be put upon the free list so that he can buy them as low as British manufacturers obtain similar goods.

But if yarns are a raw material because Mr. Bleakie uses them in a higher process of manufacture, then Mr. Bleakie's own goods become raw materials because clothing manufacturers carry the process still further and make his woolen cloth into garments.

On the other hand, if yarns are not raw materials for the reason that much human skill and labor are necessary to their production, then the farmer may reasonably claim that his fine fleeces are not raw materials because as much skill and labor are necessary in breeding and maintaining fine-wool sheep as in preparing and spinning fine yarn.

Iron ore is material for the pig-iron furnace; pig-iron is material for merchant iron or steel; and the latter are materials whose value the blacksmith or machinist or maker of watch-springs multiplies many times over. But, in the strictest sense, is anything a "raw" material unless it is a product of the earth, upon which the least passible expenditure of human labor has been made? The present tariff admits such articles free of duty as far as practicable.

Cotton, India rubber and hides are but a

few of the important materials upon which there is no duty, and the people who are demanding "reduced rates upon raw materials" would receive more attention if they would specify the articles which they desire added to the free list.

Those who wish to display machinery at the World's Fair in New Orleans or at the exposition in Louisville, Cincinnati, Philadelphia or Boston should get it ready as soon as possible. There is great advantage in being ready in good season instead of being a little behind-hand. It costs something to make a display of machinery at an industrial exhibition and pay for a man to attend it, but if properly planned and made ready it generally pays.

## The Indicator Diagram.

BY F. F. HEMENWAY.

MORE UNSTEADY GOVERNOR ACTION.

In a recent article diagrams were shown from a throttling engine in which the effect of unsteady governor action was illustrated, both with reference to producing irregular motion of the engine and to waste of steam. The opinion was also hazarded that such governor action was much more common than it was generally supposed to be. Since then I have received from an engineer in a Western city the two sets of diagrams represented in Figs. 29 and 30, which go to support this belief. They were taken from an engine at 100 revolutions, cylinder 26″x36″.

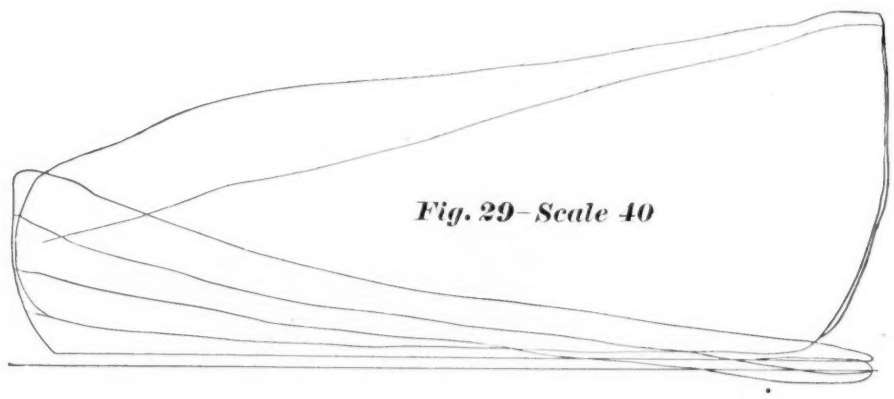


*Fig. 29–Scale 40*

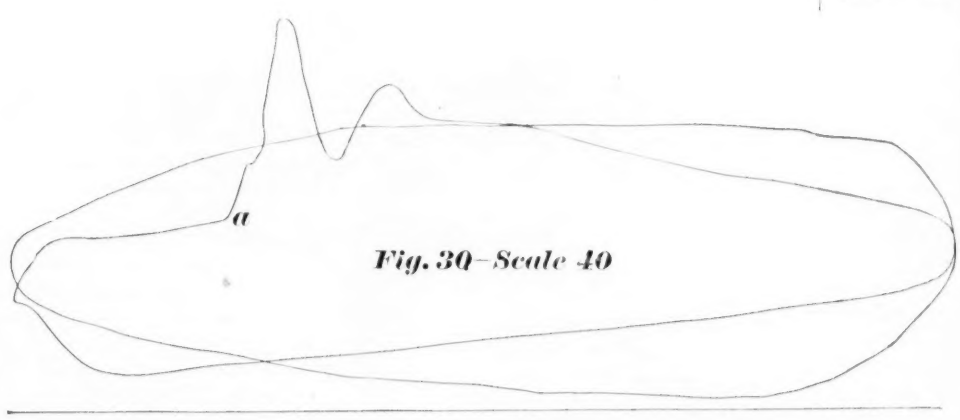



*Fig. 30–Scale 40*

In taking diagram 29 the pencil was held against the paper during several revolutions of the engine. It will be observed that the action of the governor was such that the greater part of the work was done in the end of the cylinder from which the right-hand diagram (of the pair) was taken, and that there was a very regular opening of the governor valve at about the beginning of the stroke from that end of the cylinder, admitting so much steam that the speed was increased beyond what it should have been, which brought about a closing of the valve, resulting in very little work on the return stroke, and a decrease of speed, until near the end it was below the regular speed, these changes going on with a good deal of uniformity, varying in intensity to suit, perhaps, changes in load, or perhaps varying about as represented under constant load. It is, however, probable that slight changes in load, or resistance, caused the varying intensity of governor changes. These diagrams, it may be inferred, represent about the average operation of the engine; those at the right, with the exception of a little too much back pressure, being very good throttling diagrams, while those at the left, under the circumstances of load, are very poor ones, the average economy being considerably below what it would have been if the work had been equally divided between the two ends of the cylinder.

Diagrams 30 represents a different action of the governor, and are somewhat phenomenal otherwise. The correspondent who sent me the diagrams believed, at the time these were taken, that the distortion was due to water in the cylinder, but does not see how it could bring about the results shown. He also writes that diagrams taken immediately before and after these were taken were free from the peculiarities shown in these; presumably they were like those represented in Fig. 29. I believe he is right with reference to a good deal of water being present in the cylinder, and that water was present mainly through the action of the governor. The lines of the diagram, and particularly the great increase of back pressure, as compared with Fig. 29, indicate the presence of water.

When water is carried into the cylinder in such quantities as here indicated, it is assumed—that is, if it is only a phenomenal occurrence—that the boilers have been fed too strongly, and that unnoticed the water has got above its ordinary level. In this instance the cause was probably different. Referring to Fig. 30, I infer that at a point in the stroke represented at *a* in the diagram, from throwing on work, or from some other cause, the speed was so slow that the governor valve was suddenly opened. At this point in the stroke the port would be nearly wide open, and the movement of the piston rapid, so there would be a very sudden rush of steam to keep up the pressure behind the piston, and this rush of steam would carry along with it water that was in the steam chest and in the steam pipe near the engine, water that would otherwise have found its way gradually and in a small quantity at a time into the cylinder, the effect of so much water being very prominent in the left-hand diagram, and quite noticeable, though less so, in the right-hand.

With reference to the effect on the diagram of water in the cylinder, especially in increasing back pressure, the steam is not only wet and moves sluggishly; but re-evaporation goes on during exhaust, largely increasing the volume of steam that must pass through the exhaust opening in a given time. The amount of water passing into the cylinder during a single stroke that will make an important difference in this respect is not large. Thus in an engine the size of this, doing 375 horse-power work at 100 revolutions, using dry steam, the water and water in the steam at exhaust opening would be a little more than a pint. If as much more is carried over with the steam—not a large amount in a cylinder 26″ diameter—and is all re-evaporated during the return stroke, twice as much steam must be exhausted in the same time as when the steam is dry. Whatever proportion of it is re-evaporated there is double the weight to be got out of the cylinder, the cylinder is much cooler and all the lines of the diagram are changed in appearance.

## Luminous Substances.

Persons who are of an observing turn without being very well versed in scientific matters, are sometimes puzzled how some substances such as luminous paint and jewels appear to give off light at night. It is well understood that light can only be produced at the expense of physical or chemical force, and a substance that gives forth light without any apparent recuperation seems to be performing work similar to perpetual motion. Some experiments were recently made in Paris to test this matter, a diamond of ninety-two carats being used for the purpose. It was found that this gem diffused light in the dark, but the rays of light had been stored within itself during the exposure to the sun. The stone was exposed to the sun for an hour and then taken into a dark room. For twenty minutes it gave out light enough to make a sheet of white paper visible. Being rubbed with flannel after the light had died out the gem glowed feebly again.

A reporter of the New York *Times* supplies the readers of that paper with the astonishing information that he discovered by visiting a way-station of the West Shore Railway that freight trains frequently break in two. A telegraph operator seemed to be having a joke at the expense of the reporter, for he made the latter believe that locomotive engineers had been known to run 100 miles without knowing that they had lost the tail of their train, and the reporter gravely tells this as a railroad fact not generally known.

## The Wilson Automatic Cut-off High-Speed Engine.

This is one of the types of automatic cut-off engines in which the cut-off is controlled by means of a disk governor. The two fly-wheels are so inclosed in the base as to prevent oil being thrown about, all drip finding its way to the bottom of the pit, from which it is carried off by means of a drain pipe.

The governor is arranged in one of the fly-

wheels, and in case of accidental breakage of any of its parts operates to stop the engine. The valve is a double-faced balanced slide, controlled by the governor to admit steam from zero to three-quarter stroke. The valve and valve gear are arranged for negative lead, compression being relied upon to steady the reciprocating parts, resulting, it is claimed, in very smooth running.

The cylinder has double walls, the space being filled with non-conducting material.

Alignment is secured by boring the slides, and facing the joint at the junction of frame and base.

These engines are all tested at the works, the governor being adjusted to give a piston speed of six hundred feet per minute. They are made under the supervision of the inventor, Benjamin F. Wilson, by the Madison Manufacturing Company, Madison, Wis.

Mr. D. Clark, Master Mechanic of the Lehigh Valley Railroad, at Hazleton, Pa., is using a riding cut-off valve of his own design on some of his locomotives. He speaks enthusiastically about its performance.

The United States Naval Institute, which has done valuable service in advancing the professional and scientific knowledge of officers belonging to our Navy, has made arrangements to publish a book containing descriptions of all the gun and foundry plants abroad, together with the latest adopted types of ordnance in foreign countries. We understand that the work will be an epitome of the information recently obtained by a board of naval officers that was appointed by the President of the United States to go abroad and make inquiries into the methods of gun-making followed by foreign nations. The Naval Institute shows great liberality and enterprise in publishing this valuable matter at its own expense. The Institute was formed in 1873, and few technical societies have done more valuable services to their members or to the country at large.

During the discussion in the Master Mechanics' Convention on steel fire-boxes, the opinion was expressed that British steel makers do not know how to make plates adapted for use in locomotive fire-boxes. We doubted the truth of that, for it would be hard to conceive an operation in steel making that English metallurgists cannot perform. The correctness of our belief is now substantiated by a letter to the *Railroad Gazette* from Francis R. F. Brown, Mechanical Superintendent of the Canadian Pacific Railway, Montreal. That engineer says that when he was on the Grand Trunk Railway they used Landore-Siemens steel for fire-boxes, with satisfactory results. On the Canadian Pacific Railway they are using Scotch steel exclusively for the same purpose, and it wears well. From this we would conclude that prejudice against the material is the sole obstacle to British locomotive builders using steel in their fire-boxes.

## Electric Headlight.

We understand that a satisfactory test of an electric headlight for locomotives has been made on the Chicago, Milwaukee & St. Paul Railroad, and that it is contemplated to put the light on all passenger locomotives. The dynamo that generates the electric current is placed on the forward part of the running board, a small high-speed engine doing the work.

The railways of India appear to have got beyond the experimental stage in the use of steel ties. In a recent parliamentary debate the fact was brought out that the directors of the Southern Mahratta Railway Company last year bought 99,600 steel ties from a Belgian firm.

Rubber can be firmly united to a metal surface by employing a cement of powdered shellac dissolved in ten times its own weight of aqua ammonia. A paint of shellac prepared in the same way will prevent rubber gas pipes from permitting the gas to pass through the pores of the rubber.

### Kane's Automatic Loose Pulley Oiler.

The upper part of this oil cup is glass and the lower part of rubber, covered with oil-proof coating, the whole forming the oil reservoir. From the cap at the top of the reservoir two curved tubes extend around opposite sides of this reservoir and connect with the feed channel. A screw in this channel is used for regulating the feed.

The operation is as follows: The oil cup being secured to the pulley hub in the ordinary way, when the pulley is in motion the oil will be thrown outwardly by centrifugal force. The bottom of the rubber part of the cup or reservoir is weighted and is also carried in the same direction with a tendency to decrease the capacity of the cup, which forces the oil through the tubes and feed channel to the shaft. When the revolution of the pulley ceases the elastic portion of the cup will assume its normal position, causing a partial vacuum, which draws the oil out of the tubes and into the cup.

W. Chamberlain, 107 West Second street, Cincinnati, O., is general agent for the sale of this cup.

### Points in Boiler Construction.

By George Marshall.

In a previous paper I stated that cylindrical courses of boiler shells should be made in one piece, my reasons for this statement being that the seams were the weakest part of the boiler. The custom of welding the seams of boilers instead of riveting has gained some ground in England during the past ten years, but is not making as much headway as might be expected, owing, first, to the expense of welding, and second, to the expense of repairs when repairs become necessary. It is not astonishing that recourse should be had to welding in England, when it is known that some platemakers limit the weight of a plate at current prices to four hundred-weight (448 pounds), while others limit the weight to four and one-half hundred-weight (504 pounds). In this cou 'ry there is at present practically no increase in cost for an increased width, length, and thickness, as the capacity of all our mills is adequate to furnish their regular customers with any sized plate required. Some years ago the custom was to charge an increased price for plates over a certain width and length, but our mill owners soon found their agents getting tired of sending special orders to certain mills, and ending in sending all orders to those mills giving the best accommo dations and facilities to their customers. There is great competition among mill owners as to who has the best facilities for supplying the demand for extra sizes of plate, and as a consequence of such competition all are pretty well prepared to meet any demand which may be made upon them. It is no uncommon thing here to see plates twenty-six feet in length, from 60″ to 66″ wide, and up to ½″ thick. The weight of such a plate would approach 3,000 pounds, but even this is not the limit, for some mills advertise to furnish plates 8′ 4″ wide and 30′ long, regardless of thickness, and guarantee soundness of material.

The soundness of large plates in proportion to small ones has given rise to much discussion among practical boilermakers and engineers—in fact, the question is still freely discussed by those whose duty it is to plan and construct boiler work, no uniformity of opinion having been arrived at. For my own part, I am very much in favor of large plates up to a limit of safety in proportion to the capacity of the different mills. I believe that our mill owners as a class will not sell an unsafe plate of iron to their customers if they know the use to which it is to be applied, and I also believe they will make extraordinary efforts to satisfy every demand which may be made upon them. If the capacity of a mill, in their rolls, is equal to the production of a plate 100″ wide, I think it perfectly safe to order from them plates up to, and perhaps slightly in excess of, seven feet. Whether their facilities in other respects are in proportion to their rolls is also a question to be inquired into, as, for instance, their ability to produce blooms of the requisite weight and solidity to insure a quality of plate ordinarily free from sand defects and elamination. I do not altogether agree with the idea that the Yankee nation are way ahead of all others in regard to mechanical skill and inventive genius, but I think that our manufacturers as a class are more progressive, and desirous of keeping up with the age in which we live, as far as production is concerned, than those of any other nation.

Some boiler builders have made a specialty of horizontal boilers with steel plates running lengthwise of boiler, and consequently with the grain (if any in steel plate) running in an opposite direction to the grain of the iron. This practice, if carefully carried out, should result in a good boiler, but the bottom plates must be of sufficient width to carry the horizontal seams well up out of the fire. There has been much talk, even among practical men, regarding the difference in expansion between mild steel and iron plate of equal thickness, but experiments have conclusively proved that the difference in this respect is imperceptible.

In addition to what I have previously stated as regards the placing of the horizontal seams with the caulking edge looking upward, another important matter is that the inside thickness of iron when thus placed permits of no accumulation of sediment, affording

Kane's Automatic Loose Pulley Oiler.

no projection on which it may lodge, and the seam being above the water line, practically prevents "grooving" or "channeling." These points should be carefully considered by boilermakers, as upon many so-called unimportant points the durability of a boiler greatly depends. As the study of these details necessitates a more enlightened knowledge of boiler engineering, there should be as much attention given to general detail of boiler construction as is bestowed on the development and construction of the steam engine. Many of the most important factors in the successful working of the latter consist in the smallest parts, and have occupied the attention of their inventors for many months before their utility and practical benefits were fully demonstrated.

Some builders make their vertical boilers with the grain of the metal lengthwise of the cylinder. I am pleased to say that is but rarely done, and a boiler built in this manner should be considered unsafe and dangerous, as the fiber of the metal is injured by bending, and the frequent expansion and contraction which necessarily takes place in the heating and cooling of the cylinder imperceptibly increases the first injury.

Some builders carry their ideas of safety and strength so far as to have the cylindrical seams of shell overlap from the front, thus preventing an impinging of the heat at the edge of sheet, and presenting a free passage for the products of combustion.

In a former paper I condemned the practice of carrying a flue over the top of boiler. I am pleased to notice that this practice is also condemned by other and more competent authority. From letters received since the article was published, it seems it is not generally understood how this can be done, and I have been asked how I would carry the unconsumed products of combustion to the chimney. My answer to this is by the placing of a cast or wrought iron base on top of boiler at the front end, building a wall on top of boiler to support the base at that point, and then having a stack of suitable form and dimensions made as free from bends as possible, and this stack connecting the front of boiler with chimney. In all cases this rule may not be practicable, but a little study will enable any one to overcome the apparent difficulties.

I am sorry that my remarks on the use of zinc as a preventive of corrosion and incrustation have resulted in boiler repairs being necessary, as described by Mr. Crane. I will here describe briefly the manner in which the zinc is placed in the boiler, prefacing my remarks by saying that I allude to rolled zinc, that having been found the most durable and effective: The zinc is usually in slabs of 6″x12″x1″, and the quantity varies in proportion to the horse-power of boiler—from three to seven square inches being considered sufficient per horse-power. The slabs are secured by rods and bolts or hooks to the braces. The zinc hanging in this manner from the top must be below the water line, and not in direct contact with the tubes, heads, or shell. The reasons why rolled zinc is preferable are owing to its greater freedom from impurities, and also from the fact that its closer grain prevents its being acted on by the impurities held in solution in some waters.

There is really no enumeration of the compounds and appliances introduced to prevent corrosion and incrustation, but one of the most remarkable I have yet read or heard of is the introduction of salt in solution with the feed water, the proportion given being about half an ounce to the gallon, which would lessen the necessity for inspection and cause old scale to fall off freely and be washed out. As this is only intended for those using sea water, the homœopathic doses will be understood as not applying to fresh water. I think I stated in a former paper that rain water was a very effective agent in removing scale and preventing its formation. Such is the case, but it would be well to clean the roof of the building occasionally, especially if the coal used contains much sulphur and particles from chimney and shops fall on the roof, the introduction of sulphur into the boiler resulting in greater injury than the scale.

Some engineers, when setting boilers or superintending the setting, cause them to be pitched to the rear. I can see no reason for this; in fact, I consider it an injury, as, when the boiler is set on rollers and expansion takes place, the contraction is up hill, and the tendency of contraction would be downward instead of upward, owing to the great weight. I know of one instance where a boiler was carried back one and one-half inches in two years' use, and I could assign no other reason for it than that it was set as described.

In the blow-off arrangement many boilers are injured from the fact that the blow-off pipe connected with bottom of boiler is from 3½″ to 4″, of cast iron, and the blow cock outside the walls is 2″. The effect of this reduction is an accumulation of sediment in the large pipe, which in time solidifies, leaving even less area than that of the cock, and the efficiency of the whole appliance is materially interfered with, if not destroyed, by the unexpected breaking of the casting. I know of one boiler which was badly burned from this cause. Instead of the cast iron pipe, I would suggest a flange riveted to bottom of shell with a thread cut for a 2″ pipe, and the placing in this of an elbow made with a graceful curve from 2″ pipe, and extended through the wall by a coupling and straight piece.

If the estimates for boiler work were based on the understanding that all parts of the work were to be under the supervision of a competent party, and satisfactory to him, much of the competition and many tricks now in vogue would be abolished in a short time, and honest practices prevail. Ordinarily the purchaser of a boiler thinks only of the economy of the present, no attention being given to the economy or wants of the future. The best brands of iron and steel will cost to-day about $130 a net ton, yet buyers expect to buy a first-class boiler for this price, and think labor and profit should be thrown in. First-class material and first-class labor cost money, and it is only by the payment of a fair price that either or both can be purchased. I think the day of low prices is rapidly passing away; that is, men will not be governed in their purchases by the thought of saving a few dollars. They will consult only with well-known reputable parties, and pay them a fair price for the product of shop and brain. This should be the only way in which steam boilers should be bought, as they are entirely too important to be influenced in purchase by dollars and cents alone, and it will be found that true economy consists in the purchase of first-class material wrought by skilled intelligent labor, rather than by the purchase of poor material and ignorance.

In the construction of the horizontal tubular type of boiler, instead of making the shell courses in two sheets, using the argument that a better quality of iron can be and undoubtedly is placed in bottom part, true economy would consist in the payment of difference in cost between the inferior and good iron, which in itself is very unimportant, as the labor on both is equal, and the difference in purchase price—not more than three cents per pound—in a sixty horse-power would amount to only about $40. Allowance should be made by the builder for the labor-saving effected in punching, riveting, and caulking of a seam in each course, as well as for the extra rivets used in the three double riveted seams.

Braces should be made of the crow foot pattern; the single-end brace should not be allowed to enter into boiler construction, but this practice is common in many shops where thought is given only to the output and profits, regardless of consequences—in other words, quantity not quality.

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What seemed to be a very difficult mechanical feat was performed the other day by parties who were boring a deep well beside the elevated railroad shops at 98th st., in this city. When the hole was down over 1,000 feet the drill, which is a huge iron bar 30 feet long and 4 inches thick, broke near its upper end. With much ingenuity, and the exercise of patient perseverence, a grip was made and worked down so that it firmly grasped the drill, and by this means it was brought to the surface.

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Some idea of the difficulties in the way of making large telescopes may be had from the fact that there have been nineteen failures to cast the thirty-six inch glass for the large telescope to be mounted in California.

### Allowance for Shrinkage and Finish in Patterns for Steel Castings.

Last week we received the following letter of inquiry:

*Editor American Machinist:*

In your issue of June 28th, on "The Proper Allowance for Shrinkage and Finish in Patterns," by J. Whitehead, it states, "For steel allow $\frac{1}{4}$" per foot." Enclosed please find circular of the Buffalo Steel Foundry, saying allow $\frac{1}{16}$ inch per foot. I think $\frac{1}{4}$" per foot must be right, because the AMERICAN MACHINIST says so. Would be pleased to see an answer in your "Questions and Answers."

C. F. M.

Upon receipt of the above we wrote to several manufacturers of steel castings, stating that a question had been raised about the proper allowance for shrinkage and finish in patterns for steel castings, one claiming it should be $\frac{1}{4}$" to the foot, and another $\frac{1}{16}$" to the foot, and asked what allowance each made. We received prompt replies from all those addressed, for which we here return our thanks. Below will be found the replies:

The Pittsburgh Steel Casting Company write: "We would call your attention to our circular mailed to-day; $\frac{1}{4}$" for shrinkage to the lineal foot, and another $\frac{1}{16}$", or $\frac{1}{8}$" if necessary, is sufficient for finishing. This is for crucible and Bessemer steel castings, not for annealed iron castings, so-called steel." [The Pittsburgh Steel Casting Co.'s catalogue says: "In making patterns for steel castings, allow one-quarter ($\frac{1}{4}$) of an inch to the foot for shrinkage, and also allow on the pattern whatever you may want for finishing."]

The Chester Steel Castings Company of Philadelphia write:

"The allowance for shrinkage in patterns for our steel castings is $\frac{1}{16}$" per foot. Please see directions regarding patterns on first page of our circular, which we send you in another envelope."

[The Chester Steel Castings Co.'s catalogue says:

"In patterns make $\frac{1}{16}$ of an inch per foot allowance for shrinkage.

"Make ample allowance for finishing in your pattern."]

The manager of the Standard Steel Casting Company, of Thurlow, Pa., writes:

"The shrinkage on the steel we are making at present is between $\frac{3}{16}$ and $\frac{1}{4}$ of an inch to the foot. I believe the temperature at which the metal is poured has an important influence on shrinkage."

Joseph W. Howard, (limited) of Boston, writes:

"The proper allowance for shrinkage in patterns for steel castings is $\frac{1}{4}$" per foot. In malleable iron castings the shrinkage is $\frac{1}{16}$" per foot.

"For ordinary work the allowance for finish should be a little more than for cast iron."

Stanley G. Flagg & Co., of Philadelphia, write:

"Our rule is to allow the same as for gray iron castings, viz: $\frac{1}{8}$ inch to the foot, and we find this covers all ordinary castings; unless castings are long and slender, when the contraction is somewhat more—but this is exceptional, and the above allowance is full for all ordinary patterns."

Isaac G. Johnson & Co., of Spuyten Duyvil, New York City, write:

"A good quality of crucible steel shrinks $\frac{1}{4}$ inch per foot. Other and inferior metals often called steel, shrink much less."

Mackintosh, Hemphill & Co., (limited) of Pittsburgh, write:

"We find the shrinkage of steel castings to be from $\frac{3}{16}$ to $\frac{5}{16}$ inches per foot. The larger the *bulk* of the casting the greater the shrinkage, that is, a solid round plate will shrink more than the same outside diameter cored out to a ring. The $\frac{1}{16}$ inch per foot quoted must surely refer to malleable castings, which are sometimes called steel."

The Eureka Cast Steel Co., of Chester, Pa., write:

"There is a difference in allowance for shrinkage in steel castings. We allow $\frac{1}{16}$ of an inch for our metal."

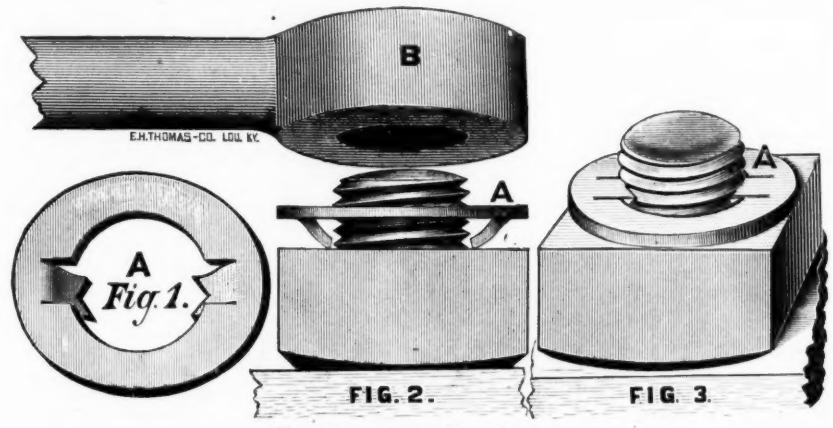
### The Van Dusen Nut Lock.

This lock consists of a washer, shown at *A* in the engravings, made of thin steel of the best quality. This washer has tongues projecting inwardly—two, as shown in the engraving, for small bolts, and four for bolts of larger sizes. Fig. 1 shows the washer detached; Fig. 2 the washer placed in position, after the nut is screwed to place; and Fig. 3 the nut locked by the washer. The tool *B* is simply a piece of iron or steel having a hole through it a little larger than the body of the bolt. In locking the nut, this is placed against the washer, and a blow or two with the hammer accomplishes the purpose. It will be understood that the teeth or edges of the tongues coming in contact with the bolt, as the washer is driven down, the tongues straighten out like knuckle joints, forcing the teeth into the bolt.

To remove the nut it is only necessary to force any wedge-shaped tool between the washer and the nut, which will bend the tongues back to their original position, when the washer may be readily removed, the washer being ready for further use.

This lock is designed for use in railroad work, on street cars, carriages, agricultural machinery—in fact, for any purpose where it is desirable to secure a nut against being jarred off. It will be recognized as a very cheap device for the purpose.

The Peerless Manufacturing Company, 635 Third Avenue, Louisville, Ky., control the patent and manufacture the lock.




THE VAN DUSEN NUT LOCK.

## LETTERS FROM PRACTICAL MEN.

### An Inquiry on the Perfect Screw Problem.

*Editor American Machinist:*

In reply to the article published in your paper of July 19th by Prof. Sweet, on "How to Keep a Screw Perfect," I should like to ask how he proposes to compensate for the errors caused by the opening and closing of the nut, and the sliding and securing of the screw-sleeve upon the feed-rod in the different positions? Should also like to know how he is to determine how much those errors are?

He may keep the 10" or 12" screw correct by running it in a nut of the same length, but the screw to be cut will certainly be *incorrect.*

GEO. F. BALLOU.

Hartford, Conn.

### Preventing Half Round Boxes from Turning in Straps.

*Editor American Machinist:*

In your issue of July 26th W. W. F., Morgantown, W. Va., tells us that he has trouble with the boxes at either end of the shackle-bar, and asks a remedy. The one recommended to him is excellent, but for these hard times most too expensive, taking into consideration that there is a cheaper way that will give the same results, which is adopted in the Brown automatic engine. The bar in this instance is solid, but the box in the cross-head end is the same shape as if a circular bent strap was used, and is held in place by putting a screw through the end of the bar and screwing into the box, holding it firmly to the end of the bar or strap.

Now, W. W. F., with the aid of a machinist, could easily fix his in the same way, only use a straight wire instead of a screw if more easily obtained.

Take off the bar and put the boxes and strap on the end of the bar, drive the grip wedge until the edges of the box come together, then drill in at both ends through the strap into the box as far as practicable, say $\frac{1}{16}$ deeper than the diameter of the wire to be used. Then take off the strap and fit a wire so that it will be a good snug driving fit all the way through the strap, and fit the end of it so that it will go into the hole in the box easily. Then drive the wire into the strap until it protrudes through the strap $\frac{1}{32}$ less than the depth of the hole in the box. Then cut off the wire on the outside of the strap and finish it up smooth.

In the size of engine mentioned $\frac{3}{16}$ wire is large enough; in small machines I like this way better than the screw. PACKING.

[W. W. F. can try this without much trouble. We shall not advise him that he will find the use of the wire entirely satisfactory. On the contrary in our experience we have found it of but little use. As between the two we favor the use of the screw.]

### Machinists Who Leave the Trade.

*Editor American Machinist:*

One reason why so few boys are learning the machinist trade is, there are so many men learning it. I know of one pretentious city in which are six shops, and not one of them is owned and controlled by a practical machinist.

Nearly all these shops were started by practical machinists, who, after investing all their savings, and struggling along for a time, had to give it up and let some man with money have the shop at his own price, which was cheap enough so that he could afford to learn the business, or so much of it as he could learn by beginning at the top. And he does not want to be bothered with apprentice boys, so he says, and I think, likely he speaks the truth. GRUMBLER.

### Gambier for Preventing Boiler Scale.

*Editor American Machinist:*

We have noticed for some time past some remarks in your paper about scale preventives, and as we have had some experience with one kind, we desire to add our mite and ask for information from those who have used the same.

We have for some time past been using a vegetable substance called gambier, which, we understand, comes from the West Indies. It appears to act very well. It has loosened the scale which was in the boiler, and it appears to prevent the formation of new scale. It is a substance of a dull brick-red color, and has a consistency about like soft putty, unless exposed, when it hardens. It readily dissolves in water. We put a lump about the size of a walnut in the boiler before making fires, about once or twice a week. We have opened the boiler twice since using it, and have found very little scale on the surfaces, and but little loose scale in the legs of boiler. We have an upright tubular boiler, and carry about 55 lbs. pressure. We pay but ten cents per pound for this substance, and are inclined to think it acts well. We would like to know from some of your readers who have used it if they can find any injurious effects in the iron from its use, for we have not had it in use long enough to see any injurious effects.

WILLIAMS & KEMP.

Fayette and Frederick Streets, Baltimore, Maryland.

### Estimating the Weight of Cast and Wrought Iron.

*Editor American Machinist:*

Your correspondent, in the MACHINIST of August 2, who divides cubic inches by 4 for pounds of cast-iron, can just as easily arrive at much greater accuracy. Let him add one-twentieth to his quotient, thus:

4)1728 cubic inches.

2)432

21.6

453.6 lbs.

of cast-iron per cubic foot. As most castings are strained a little beyond their nominal dimensions, the error, if any, is on the right side.

For wrought iron one-tenth should be added, thus:

4)1728

432

43.2

475.2 lbs.

of wrought iron per cubic foot, which is a very good average.

A. B. COUCH.

Philadelphia, July 23.

We have received from M. T. Richardson, publisher, of Warren Street, New York, a small book entitled, "How to Tell the Age of a Horse." It is, no doubt, a valuable form of publication for people interested in the ancient form of motive power. To us, however, a book devoted to the subject of "How to Tell the Age of a Boiler" would be much more acceptable, and we respectfully commend that subject to authors and publishers.

### Cincinnati Railroad Shop Notes.

The Cincinnati, New Orleans & Texas Pacific Railroad Company are about to order sixteen new Mogul locomotives, to take the place of lighter engines, which are needed for a Southern division of the road. This company have under way in their own shops two passenger engines, 18x24-inch cylinders, with wheels 68 inches diameter. The top of the straight part of boilers will be 9 feet 9 inches from rail, and all passenger engines hereafter made for this road will have highly placed boilers, as experience with engines of this kind recently constructed indicates that they ride very easy, besides allowing for a larger shell than engines with boilers placed lower down. A shifting engine with cylinders 18x24 inches, and six coupled wheels, is also building at the same shops. The new Mogul engines mentioned will be fitted up with Chicago crucible steel tires, as it is found that engines doing heavy work will remain out of the shop longer with them than where open-hearth steel tires are used. The passenger engines will have Miltimore steel tires throughout. Mr. Meehan has found that the flanges of steel-tired wheels in engine trucks never cut the flanges since he gave $\frac{3}{4}$-inch of lateral play, and $\frac{3}{8}$-inch taper on tread. Formerly he made a straight tread, and gave $\frac{1}{4}$-inch lateral play. There was a good deal of trouble from cut flanges under that arrangement.

A new gear cutting machine has been patented by Higgins & Eastman, Manchester, N. H., in which a gear-supporting arbor and tool carriage bed are combined with feeding and guiding mechanism, to cause one to approach the other in one plane of movement. The tooth-shaping is regulated by a template and co-operating support, the latter being attached to the tool-carriage bed, where it is made to control the feeding movement and the cutter. The cutting device is made after the shaper pattern. The tool seems to be very ingeniously planned, the only objection we see to it being that its mechanism is a trifle complicated.

## The Brown Rubber-Cushioned Helve Hammer.

In this hammer the arrangement is such that three-fifths of the revolution of the crank is used to raise the hammer, and two-fifths to deliver the blow, thus slowing the upward and correspondingly accelerating the downward movement, thereby increasing the force of the blow.

The hammer is readily adjusted to large or small work, by being raised or lowered at the trunnion bearings by gearing and screws which raise both sides alike.

The helve pitman is adjustable to length by right and left hand connection, with clamp bolts to hold rigidly when adjusted. The length of stroke is quickly adjusted without disturbing the relative position of hammer and anvil.

The helve is adjustable up or down, or to either side. The anvil is also adjustable to either side. The force of blow is under perfect control at any time.

The diagram of crank motion shows the arrangement by which three-fifths of the crank motion raises the hammer, and two-fifths brings it down:

The rock shaft *K*, *M* rocks on its trunnions *G*. Shaft *A* drives crank *B*, which by a pitman is connected with the rock shaft at *C*. *H* represents the adjustable sleeve, sliding on outer arm of rock shaft *M* to change the length of stroke as desired. It is clamped to place by a screw at *e*; *h* represents wrist pin, connecting sleeve *H* to pitman *P*, the other end of pitman *P* being attached to the cushion arm actuating the hammer helve.

Circle *B D E F*, divided into 20 equal parts, shows the movement of the driving crank *B*. The curved line *C C*, numbered on one side 1 to 12, shows the relative movement of rock shaft at *C*, while crank is moving from 1 to 12 in its revolution to raise the hammer; and 12 to 20 is corresponding movement, while the crank completes its revolution through the 8 remaining spaces to its starting point, delivering the blow.

This hammer is made by the Knowlton Manufacturing Company, Rockford, Ill.

## Senators to Investigate Ordnance and Shipbuilding Matters.

Congress has authorized the appointment of a committee of five Senators to examine into the capacity of the steel-producing works of the United States to make steel suitable for guns of high power and plate suitable for covering iron-clad ships of war. They also will have power to inquire into the character and efficiency of the tools, in the navy yards and Government foundries, suitable for the manufacture of engines and guns for heavy war vessels and guns for seacoast defences; also to inquire as to the best methods of manufacturing the same; whether by Government or by contract by private parties. This work of investigation has already been done by a board of naval experts, who were competent to judge what was needed for the re-construction of the Government's shipbuilding and ordnance establishments, and a very practical report was made to Congress. In following their investigations this board visited most of the leading arsenals and shipbuilding yards in Europe, and their labors were very thorough. Nothing could be conceived as less competent to perform work of this kind than a committee of Congressmen, like what is now going to perform the farce of inquiring into difficult subjects which requires high scientifical and mechanical knowledge to comprehend the questions involved. This committee will likely succeed in spending a great deal of money junketing around during the holidays and pretending to be engaged in deciding mechanical problems they do not understand, but the Nation will certainly reap no benefit from their pretentious labors.

More than 300,000 patents have been issued from the United States Patent Office; hence the difficulty of a search to determine whether or not some device is already patented. The difficulty is a growing one.

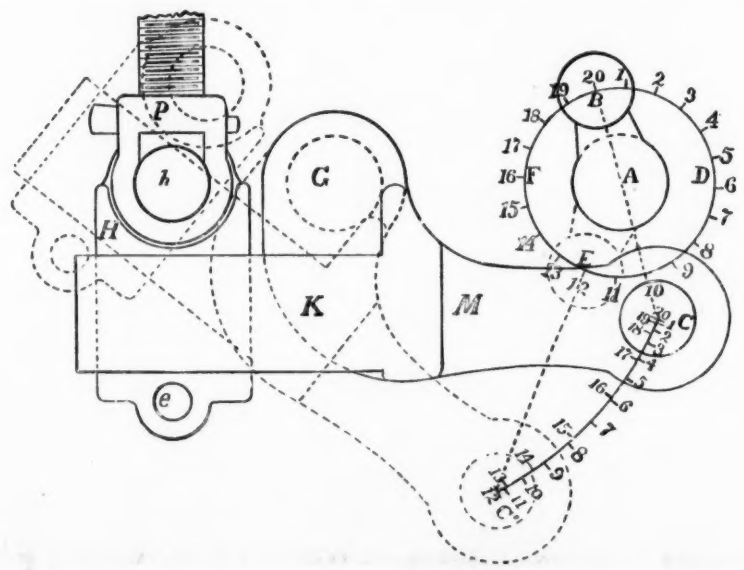
## Early Engineering Reminiscences.

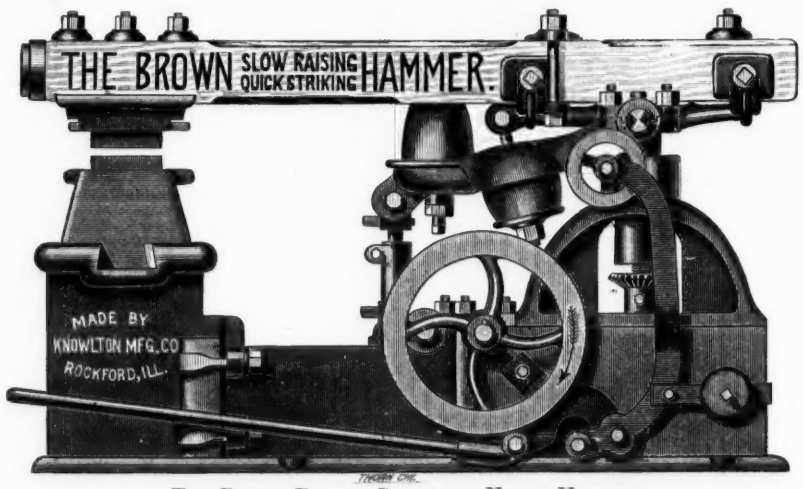
By George Escol Sellers.

FOURTH PAPER.

I have alluded to the activity in mechanic arts during the few years preceding the organization of the Franklin Institute; I now propose incidentally to speak of some of the leading spirits that conceived of and organized that institution, in what was truly a transition period.

It is hard for the machinist of the present day to realize that, at comparatively so recent a period, bedposts, legs, and rounds for the old-fashioned Windsor chairs, spade handles, rolling-pins, and the like, were turned on spring-pole lathes, operated by a foot treadle, one-half the time being lost in the backward motion of the piece being turned. Although the wheel and crank attachment to the foot treadle had been adopted for a long time, and was used by the better class of workmen, it was not until two or




The Brown Rubber-Cushioned Helve Hammer.

three years previous to 1824—the date at which the Institute was organized—that the wooden grooved treadle wheel, for cat-gut or raw-hide round belts, gave place to the cast-iron wheel and flat belt. This innovation was made by Isaiah Lukens, and was followed by Mason and Tyler. These wooden crank or treadle wheels were constructed of segments of hard wood, beech or mahogany, so arranged as to present the end grain of the wood to the periphery of the wheel, the depth of the felloes being about 5″; width of face, say, 4″, admitting of three grooves of the required diameters to change the speed of the lathe mandrel without varying the speed of working the foot treadle. To give weight to these wheels to act as fly-wheels, and to counterbalance the crank and treadle, rows of holes around the rim on its sides were bored, and cast full of lead. As late as 1828 the spring-pole lathe had not entirely gone out of use for chair rounds and spade handles, nor had small steam engines, now so extensively used, taken the place of the big wheel turned by man-power, for heavy lathe work, or to drive the grindstones and emery-wheels of the cutlers, and surgical instrument makers in the cities.

It was about the year 1822 or 1823 that a Maudsley slide-rest, then a new thing in England, found its way to Philadelphia. It was taken hold of and greatly simplified by Rufus Tyler, who was at that time making small iron shear foot-lathes, he having adopted the steel mandrel, conical on its front bearing, running in hardened steel collars, and also the push-pitman to the treadle, instead of the ordinary hooks (this was original with him). The lathes and slide-rests of Mason and Tyler were certainly the best tools made for sale at that time.

Isaiah Lukens was chiefly engaged in making town clocks; but found time, with never more than the assistance of one or two men, to finish two or three small lathes and an air-gun or two in the course of a year, for which there were always ready purchasers. He also got up a simple slide-rest. To cut the screws for it he converted one of his little iron-shear foot-lathes into a very effective slide lathe, with gearing to cut screws of various pitches. The bed-plate of his slide-rest was wrought iron forged with a drop stud or spindle that was turned to fit in the ordinary rest-carrier, to take the place of the common rest. The face of this bed-plate was 9″ long by 3½″ wide, the cross-head having a travel on it of 5″, and the tool-carrying block or head a traverse of 2¼″. These measurements are not given from recollection, but from a Lukens' slide-rest now by me, that has been in my possession over sixty years, and in use *most of that time*. It is in good condition now. It is not like the boy's old knife, that first had a new blade and then a new handle; for the bed-plate, with its screw and traveling-head, are as originally made. The tool-carrying cross-moving head was of brass, and wore out by clamping in the turning tools. I renewed this with cast iron, but in every respect like the original. It affords me great pleasure to give a history of this old slide-rest, as it enables me to pay my tribute to one of the greatest of our pioneer mechanics, who was emphatically the young beginner's best friend, and a sound mechanic to the core. He was a bachelor, of rather eccentric habits. He lived in his shop, sleeping in an adjoining room, taking his meals at an old hostelry on Market Street, largely frequented by the farmers of Chester and Lancaster counties, where he would meet his friends and relations from the country. He was naturally of a social disposition, although an impediment in his speech made him appear shy and diffident in ladies' society. He called his shop his wife, and he really loved it. He also loved his old grey horse that he kept at the stables of the Market Street tavern, and either in the morning before "sun up," or on moonlight evenings he would have him hitched to his yellow two-wheel top gig and take lonely rides, unless he chanced on some boy to whom he had taken a liking, then he would claim him for company. He always took a summer vacation of from six to eight weeks. At these times he would lock up his shop, and with his fishing tackle, mineral hammer, and change of clothes in his gig box, his trusty air-gun by his side, he would drive off on his solitary excursions, never hinting to his most intimate friends what course he would take. I doubt if he knew himself; but he was free to be guided by circumstances. There is scarce a point of interest to the mineralogist in northern New Jersey, eastern and middle Pennsylvania, that he did not visit, even extending his lonely drives as far South as Washington. Lukens lost an eye from a chip of steel when dressing a grindstone. Up to that time he was certainly the finest workman in Philadelphia, but afterwards he was fearful of trying his remaining eye on very fine work. He took an assistant—I cannot say as to an apprentice; he called him his pupil, and he did honor to his preceptor. I refer to Joseph Saxton, who has left his mark in his scales for the U. S. Mint, in instruments for the coast survey during his long connection with Prof. A. D. Bache, and as head of the Department of Weights and Measures of the United States.

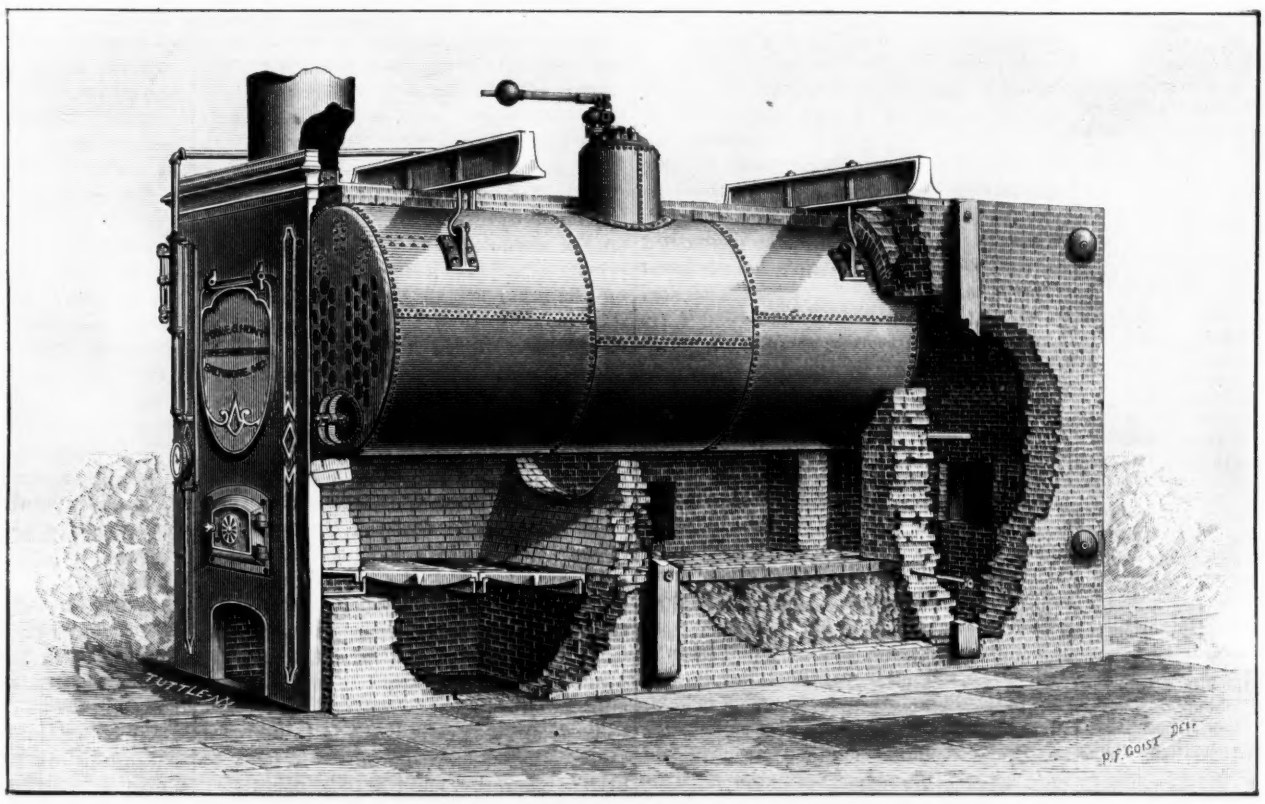
From the time of Saxton's coming to Philadelphia we were intimate and warm friends until his death. The first summer vacation of Lukens' after Saxton commenced to work with him, his shop was not closed as usual, but Saxton was left in charge, to "tinker," as Lukens said, with anything he liked. He planned, and was making for himself a cane gun. My elder brother and myself each concluded to make one; and, although we had every facility of the time to do the work in the shop our father had fitted up for us, there was a small portion of the work could be better done with Lukens' slide-rest. I was in his shop beside Saxton doing that little job, when Lukens, who had unexpectedly returned from his summer trip, came in. He looked at, and asked what I was doing. On examining the plan he suggested some slight alterations. Saxton showed his gun that was completed. He had worked out the plan himself, and Lukens was greatly pleased with its simplicity. He had returned in improved health and spirits, and asked why I did not make a slide-rest for myself. He then produced the forging of my rest, and said he had rough-chipped it, had turned the stand stem, and it would fit my father's rest-carrier, and was about the right height for his lathe. He therefore told me to take it, and try my hand on flat-filing. We had no planers or shapers in those days. The hammer and coldchisel had to do the rough work on forgings, often far from perfect, and with plenty of stock left them to remove. In this case the rough work had already been done by Lukens. He loaned me his patterns, from which I had the brass castings made. I cut the screws on his lathe, and did most of the work in his shop, occasionally helped by himself or Saxton. The pleasant associations connected with this slide-rest have, no doubt, been the cause of my preserving it, and using it as a favorite tool during these long years. I have related the circumstance to illustrate the considerate kindness of Lukens to earnest beginners.

After Saxton closed his term with Lukens, to perfect himself as a machinist and to enlarge his views, he went to England and spent several years there. In the fall of 1832 I found him with Jacob Perkins, at the Adelaide Gallery, London, where Perkins was exhibiting his steam generators, circulating boiler, steam gunboat propeller, etc. Saxton was then working on an electro-magnetic engine, to help out the attractions of

the Adelaide Gallery exhibition. He laid aside his work, and with me and John Isaac Hawkins visited all the prominent mechanical works that were accessible — Maudsley's, Donkin's, Brunel's at the Thames Tunnel (though the work at that time was temporarily suspended), and many other places of interest to a mechanic. From our freedom of access to works that had been closed against Americans, the friendly and familiar terms Saxton was on with the elder Stephenson, Hartley, Brunel, and others, it was evident that he was appreciated; in fact, Mr. Bryan Donkin said to me, "that as a workman and inventive mechanic, he considered him the shining light of the day." This was high praise, coming from the man that Sir Walter Scott, in one of his works, speaks of as "Honest Bryan Donkin, the Machinist." In getting access to establishments that Saxton had failed to, we owed much to Hawkins. He was a remarkable man; a most prolific inventor. He was born in England, but came to America when quite young. He was an enthusiastic Republican, and as soon as possible became a naturalized citizen. His first employment in America was with my mother's father, Charles Wilson Peale, in making his polygraphs, or manifold writers — some with two and some with three pens. At Mr. Peale's suggestion and general contrivance, they got up the Physiogmatrace, so long an attraction at Peale's Museum, when in the upper rooms of the old State House or Independence Hall. There are many now living who recollect this wonderful instrument, as it was considered before the time of photography. It was handled by Old Moses, a light mulatto, a former slave in the Peale family, and there were very few visitors to the museum who did not take away with them a half sheet of letter paper, folded in four, on which the physiogmatrace had outlined their profiles, which were cut out with fine scissors by Old Moses. To mount these silhouettes on black paper, frames were required. Here came Hawkins' ingenuity into play. He invented and got up a lathe for turning oval picture frames of wood, which he ebonized. He made a number of upright cabinet pianos. He invented and constructed a grand musical instrument that he called the clavial. It was a very ingeniously devised revolving horse-hair band, against which, by keys arranged as in the ordinary piano, violin or cat-gut strings were drawn — in fact, a great violin, with a string for every note. It was not a success, out of his own hands; and even in them it would take him the best part of a day to tune it for an evening exhibition. While he remained in America he carried on an extensive series of experiments on boiling or evaporating under vacuum, and perfected his system of sugar vacuum pans. With this he returned to England, and secured it by patent. Then followed the great mistake of his life. He could have sold his rights for what would have given him an ample competency for life, but he was persuaded that royalties would be better for him; so for one thousand pounds down, and a stipulated royalty on savings, he conveyed his entire rights for England and her Colonies to a strong combination of sugar refiners, making no stipulations as to working his system. They gained their object, which was to lock it up during the entire period of his patent-right. He expended more than he had received in litigation, and failed in forcing its use or getting any compensation for it being kept idle; by the time the patent expired grand works had been erected and were ready to go into operation. During all this time he was tied to England, though his heart was in his adopted country, and he was evolving from his prolific brain invention after invention, in order to obtain a support and to carry on the litigation, in the vain hope of securing the reward justly due him for his vacuum evaporator. Many of these inventions were sold for small amounts and brought out under the name of the purchasers. I will only mention two of these — two that the world has profited by, and which we all carry in our pockets without knowing to whom we are indebted for them. I refer to the "diamond-pointed gold pens," and the "ever-pointed pocket lead pencil." They came out in London as Mordant's diamond-pointed pen, and Mordant's ever-pointed pencil. To Hawkins alone belongs the credit of the discovery of, and the mode of attaching the alloys Osmium and Iridium to the points of gold pens, and finishing them for use. This invention, as well as the ever-pointed pencil, he sold to Mordant for a certain amount down, and small royalties: I do not recollect what, though he showed me all the accounts connected with it, as well as a list and statement of what he had received for other inventions. I spent an evening with him in his den on Hampstead Road, London, seeing him operate a most ingenious machine that he was then keeping a profound secret, I being the only person he had ever shown it to. It was a machine for working out or carving statuary in ivory, reducing from a model. He had in the machine a nearly completed miniature bust of Washington, about 3 inches high. The template, or model, he was working from was a plaster cast of Hudon's celebrated bust of Washington. This little ivory bust was a most exquisite piece of workmanship as it came from the machine, requiring very little hand-finish. At that time he was working on a large machine for full-size marble statuary. I have never heard how he succeeded with this. While I was residing in Cincinnati — I cannot with certainty fix the date — I received a letter from my mother saying she had had a visit from her old friend, John Isaac Hawkins, and that he requested her to say to me that he had returned to America to lay his old bones in the soil of his adopted country: but, notwithstanding he was fast approaching 90 years of age, he fully expected to get out as far as Cincinnati to see me, if I could not go East to see him, but we never met. I have an impression, but cannot vouch for its correctness, that he settled in Trenton, N. J., and died there.

## New Side Wheeler Engine.

In the machine shops of the Morgan Iron Works in this city there is an engine in course of construction for a new steamer belonging to the New York and Providence line that radically departs from our usual style of side-wheeler engines. It is an oscillating compound surface condensing direct acting side-wheel engine, and is the first of the kind made in this country. This type of engine has always been used by side-wheel steamers in England, and it has many advantages over the beam engine that is so common to American steamboats. The oscillating engine occupies less room, and the weight of the machinery is carried much lower down than that of the beam engine. which adds immensely to the vessel's stability. There are to be eight tubular boilers capable of sustaining 80 pounds pressure. The engines consist of one set of oscillating cylinders, the low pressure one being 78 inches in diameter, and the high pressure 42 inches, with 10 feet 6 inches stroke of piston. This stroke also excites much comment owing to its length.




HORIZONTAL TUBULAR BOILER AND SETTING.

As can be seen by engineers, the feature of the stroke of the engine is strictly American, being so much longer than the English stroke, which would be about six feet. The long stroke has always been much favored by American marine engineers, who claim for it a higher degree of economy than the short-stroke engine can produce. This departure will be watched with much interest by many experts in engine economy, some of whom assert that so long a stroke for this type of engine is incompatible with a practical efficiency.

The officers of the Chicago, Burlington and Quincy Railroad appear determined to extend the principle of prohibition from the Iowa portion of their road into the other States traversed. A recent order says: "Station agents, train and engine-men, and telegraph operators, who are known to visit drinking places, shall be warned that they must stop at once. If they persist, they shall be discharged, and shall not be employed again without the consent of the general manager. Any of these men known to have been drunk either on or off duty shall be discharged. Special cases, where it is the first offence, may be dealt with at their discretion; but if the same man is found drunk the second time, he must be discharged."

A correspondent, who does not sign his name, and who asks us to answer a question to decide a bet, is informed that the object of the question and answer department is not to furnish means for deciding bets; also that no question unaccompanied by the writer's name and address is answered.

The natural gas found around Pittsburgh is so volatile that it is exceedingly hard to control. In some experiments made at the Penn Gas Fuel Company's Works, East Liberty, a four-inch cast-iron pipe was closed at the end with a heavy cap screwed on; then the gas, of a pressure of 175 pounds to the square inch, was turned on to the pipe. On applying a torch to the outside of the pipe, flames rose all over it, and the discovery was made that the gas passed through the pores of the iron like water through a sieve. An inconvenient and dangerous quality about the gas is that it emits no odor, and consequently it is difficult to find out when or where the gas is escaping.

## Horizontal Tubular Boiler and Setting.

The accompanying engraving represents the practice of Poole & Hunt, Baltimore, Md., in the construction and setting of stationary boilers. It will be noticed that the distribution of tubes is such as to permit good circulation, and facilities for cleaning, which is further provided for by the location of a large manhole in front and over the fire. The engraving shows one of the side walls removed, exposing the arrangement of grate-bars, bridge-wall, etc. The mountings and iron work furnished with boiler are well represented, and require no explanation.

Some months ago we illustrated a device, used by Mr. Bushnell, Master Mechanic of the Burlington, Cedar Rapids & Northern Railway, for turning tumbling shafts without having to swing them in the lathe. Mr. Bushnell is somewhat proud of the way the rig works, and likes to show it to visitors as a novelty. The other day the master mechanic of a neighboring road was visiting the shops at Cedar Rapids, and Mr. Bushnell took him to see the method he had of turning the tumbling shafts. "Why," said the visitor, on looking at the rig, "I have got one like that in use, having taken it from the AMERICAN MACHINIST." Mr. Bushnell now thinks that he will not again talk of anything of a novelty after he has sent it to the AMERICAN MACHINIST.

Calling buildings fire-proof that are not so leads to a good deal of trouble, often to the loss of valuable property, and frequently to the loss of life. A great many buildings in large cities are advertised as being "fire-proof." There may be some that are really so, but even this is questionable. At any rate, a large majority of the buildings rented as fire-proof are far from being so. It is wrong to induce a false feeling of security by such misrepresentations, and the authorities are not guiltless in the matter. If by the expression "fire-proof," as applied to a building, is meant that it will not burn quite so readily as some others, then this is what should be said of it. In the meantime, it is better for all to understand that the buildings in which they live, or do business, are liable to destruction by fire, and to make their calculations accordingly. Doing this would often save unnecessary loss of life and property.

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NEW YORK, AUGUST 9, 1884.

CONTENTS.


| | PAGE |
|---|---|
| Williams Inertia Instrument | 1 |
| Best Method and Material for Lubricating Valves and Cylinders | 2 |
| Campbell's Exhaust Condenser, or Condenser Head for Non-Condensing Engines | 2 |
| What are Raw Materials? | 2 |
| The Indicator Diagram. By F. F. Hemenway | 3 |
| Luminous substances | 3 |
| Electric Headlight | 3 |
| Kane's Automatic Loose Pulley Oiler | 4 |
| Points in Boiler Construction. By Geo. Marshall | 4 |
| Allowance for Shrinkage and Finish in Patterns for Steel Castings | 5 |
| The Van Dusen Nut Lock | 5 |
| Letters from Practical Men—An Inquiry on the Perfect Screw Problem—Preventing Half-Round Boxes from Turning in Straps—Machinists who Leave the Trade—Gambier for Preventing Boiler Scale—Estimating the Weight of Cast and Wrought Iron | 5 |
| Cincinnati Railroad Shop Notes | 5 |
| The Brown Rubber-Cushioned Helve Hammer | 6 |
| Senators to Investigate Ordnance and Shipbuilding Matters | 6 |
| Early Engineering Reminiscences. By George Escol Sellers | 6 |
| New Side-Wheeler Engine | 7 |
| Horizontal Tubular Boiler and Setting | 7 |
| A Free-Trade Victory | 8 |
| Cable Railway Propulsion | 8 |
| The Cooper Union | 8 |
| Manufactures | 9 |
| Questions and Answers | 9 |
| Machinists' Supplies | 10 |


## A Free Trade Victory.

Foreign newspapers are fond of sneering at American methods of doing business, but it seems that foreign merchants are not adverse to following even the worst American methods when they can do so with advantage to their interests. Some time ago a pool was formed among the leading British steel makers for the purpose of maintaining prices, and its details were as carefully arranged as if it had been managed by an American railroad freight agent. This steel pool appeared to bring unlimited comfort to the pockets of the members for a few months, but a source of trouble has lately been encountered that is likely to bring the whole scheme to grief. The pool was not wide enough. It failed to cover the operations of Continental rivals, and they are carrying away business by under-selling the pool combination.

The government of India requires a great deal of steel and iron for maintaining and constructing the railway system, and the steel makers of Britain were requested to make offers on contracts for furnishing a large quantity of steel sleepers, rails and iron car material. The managers of the pool feeling that the matter was in their own hands, arranged that the bids should be limited in number, but very high as regards prices. Instead of quietly paying British manufacturers the prices demanded, the Under Secretary for India protested that the steel makers had formed a ring for the purpose of controlling business in an illegitimate way, and the scheme was denounced as contrary to all Britain's long boasted principles of free trade. The steel makers thinking their position was unassailable remained firm, and so did the Indian government officers, with the result that the contract was given to a Belgian company. It was bad enough that benighted China, bigoted Spain, and other nations lacking in sound political intelligence, should desert free-trade Britain and go for machinery and ships to continental nations that still indulged in protective practices, but for India, which means part and parcel of the British monarchy, to do likewise seemed intolerable. The steel makers' pool felt that they were being wounded in the house of their friends, and as it could not be expected that human nature would endure such injustice tamely, they raised the wildest kind of a yell against the injury wrought upon their business, and they plainly intimated that the officials responsible for the action taken by the India office were robbing honest Englishmen of their bread and butter. The matter was brought before Parliament and argued with considerable acrimony in the House of Commons, where the friends of the India office argued their case on the pure principles of free trade, and came off victors. Of course it is very gratifying to the friends of sound political economy to find that free trade scored another victory, but the Belgian workshops are busy on the contracts.

## Cable Railway Propulsion.

We have received in pamphlet form the report of a paper regarding the above subject, read by Mr. W. W. Hanscom before the Technical Society of the Pacific Coast in June last. It describes accurately the method followed in building the principal cable roads in San Francisco with the appliances used in operating, and the descriptions are made more intelligible by numerous cuts. As the work was done under Mr. Hanscom's direction, and numerous parts of the machinery and appliances were his own invention, he is eminently capable of giving details of how cable railroad propulsion is carried out; and he has performed valuable service to those interested in the subject by elucidating a department of mechanical work that had been little written about. Cables and grips—the troublesome part of cable railways—are intelligently discussed, and Mr. Hanscom's views thereon will probably be useful to other engineers engaged on similar work. The conclusion arrived at, as how power is expended in operating cable railways, is somewhat startling, since it has generally been understood that a high proportion of the power was used in moving the passengers. According to the figures given 68 per cent. is expended in moving the cable, 28 per cent. in moving the cars, and 4 per cent. in moving the passengers.

By a letter from Mr. Hanscom, published in a recent issue, our readers will understand that he went to London and superintended the construction of the cable railway recently opened for traffic in that city. Writers in British technical papers, who, in some cases, minutely described the details of the cable railway, and expatiated upon the difficulties of construction, were careful to omit mentioning that the work was done under the direction of an American engineer.

The bill to prohibit the importation of foreign contract labor was smothered in the Senate before Congress adjourned. The same demagogues who aided to smother it there are now posing as the special friends and champions of the workingmen. They should be known by their records rather than by their professions. The people demand a law to prevent the importation of hordes of semi-civilized Hungarians and other half-starved laborers, but they cannot trust those who have played them false as lawmakers while pretending to favor such a law.

As a result of lack of appropriations, a large number of men are again laid off work on the capitol building at Albany. If a private enterprise were managed the way the State has managed the construction of this building from its commencement, it would have ruined any ordinary concern undertaking it. These same politicians who so manage affairs as to throw the workmen on the capitol out of work two or three times a year, are always engaged about election times in preaching to workingmen of their efforts to arrange the affairs of government so that labor shall find "constant employment at good wages." But when they get the management of some enterprise requiring labor into their hands, their actions show how little truth there is in their preaching. This building at Albany, the management of the construction of which every citizen of the State of New York has reason to be ashamed of, will, it is safe to say, cost more than double what it would if built by private enterprise, and it is to be paid for by the hard work of workingmen, some of whom have tried to make a living by working upon it, in many instances paying a bonus to some petty underling for the privilege, and have been provided with anything but the "steady employment" about which political mountebanks harp so glibly.

James F. Brown, 1236 Woodbine street, Philadelphia, writes us at length to say that the greatest display of steam engines ever made was at the Southern Exposition at Louisville last year. The tests, however, were not properly made, the committee refusing to apply the indicator. The medal awarded was not therefore of any value as an advertisement. He hopes the same mistake will not be made this year, and closes by saying: "Each engine deserves a gold medal, so if they can't give one to all, do not give one to any." We hope they will not give a medal to anybody. We never knew of a competitive exhibition of engines, boilers or machinery of any kind resulting in the award of a medal to one of them "for superiority" that did not stir up a quarrel, lasting at least two years after the fair closed. We would sooner advise an engineer to run for office in a locality where the heelers all expect to be "taken in out of the cold, and have their toes warmed" than to become a judge or an expert at an industrial exhibition where medals are to be awarded, based upon his decision. When engineers of ability and reputation cannot be engaged to conduct trials or make examinations at fairs where medals or premiums are at stake, the foolish practice of making such awards will be at an end. The tendency is strongly toward the end of that practice now. We advise Mr. Brown to continue using his cudgel on the committee that decided the awards last year, and upon any other like committees that are to make awards this year.

## The Cooper Union.

The Twenty-fifth Annual Report of the trustees of Cooper Union is on our table. We are profoundly impressed with the important educational work this institute has done for the industrial classes of this country since it was endowed by the late Peter Cooper in 1859, and all our sympathies are in favor of the scope of the institute being extended. It is then with deep regret that we learn from the annual report that although the applications for admission to the Union continue to increase, increase of educational facilities is prevented through want of funds. To quote the report:

"The Trustees regret to say that, while there is an overwhelming demand for the privileges of the Institution, so much so, that in some departments applicants are compelled to wait for more than a year before admission can be granted, the Institution has reached the limit of its usefulness, with the space at its command, and the money available for its support. Its income is mainly derived from two sources—from the rents received from portions of the building which are leased to private parties, and for the use of the great hall for public meetings. It has also an endowment of $200,000 provided, during his life time, by Peter Cooper, from which last year the revenue was $11,050. By the terms of his will Mr. Cooper gave $100,000 to the Institution, the interest on which will be sufficient, in addition to his previous endowments and the rents, to defray the ordinary expenses, upon the scale of usefulness which is provided for by its present organization; so that it may be said, that Mr. Cooper not only founded the Institution and erected the buildings, but has provided it with means sufficient for the extension which was given to it during his lifetime.

"But if the endowment were larger, it would be possible greatly to enlarge, and probably to double the usefulness of the various departments of instruction now opened to the public. Such an enlargement would require more space, which could only be had by a reduction of rented space. This reduction would have to be replaced by additional endowments. The Trustees have no doubt whatever of the propriety and the necessity of enlarging the work of the Institution. If the portions of the building now rented could all be appropriated to the work of instruction, it would be possible certainly to double the facilities now offered freely to the public. The annual expenditure involved in such an enlargement would undoubtedly require an endowment of one million of dollars, in addition to the present funds of the Institution. This statement is made because some suggestions have appeared in the public journals, that it would be well to signalize the great change which has taken place in the loss of its founder and its benefactor, by raising a fund which would enable his designs to be carried out to their final completion. The Trustees think it is a proper time for them to say that Mr. Cooper never expected to be able, of his own means, to accomplish the full realization of his plans, and would gladly have welcomed any addition to the funds of the Institution from any source whatever. If, therefore, it should occur to any one, in the disposition of his means, to make a gift to the Cooper Union, the Trustees desire it to be understood that such gifts will be gladly received; and that in the enlargement of the School of Design for Women, in the establishment of a Reference Library on a larger scale, and particularly in the creation of an Art Library, designed especially for the use of the pupils of the School of Design, and of a Museum of Art, and of mechanical models, containing specimens useful to the formation of taste and embodying examples of special excellence, there is abundant opportunity for

endowments to the extent of a million of dollars; and this sum, sooner or later, the Trustees hope to secure for the Institution. The children of Mr. Cooper have already notified the Trustees that, in accordance with what they understood to be Mr. Cooper's final wishes, they will contribute the sum of $100,000, in addition to the bequest of $100,000 contained in his will."

We sincerely hope the Trustees of the Cooper Union will obtain the financial aid the institution needs and so richly deserves. The Union has its work arranged with especial reference to the wants of the working classes; its training is admirably calculated to instruct, elevate and improve these classes; and many working men and women have had their condition in life greatly elevated through the training they received at the Union. The lines of instruction followed are:

*First:*—Instruction in the branches of knowledge which are practically applied in their daily occupations, by which they support themselves and their families.

*Second:*—Instruction in the laws by which health is preserved and the sanitary condition of families improved; in other words, in personal hygiene.

*Third:*—Instruction in social and political science, by virtue of which communities maintain themselves, and nations progress in virtue, wealth, and power.

*Fourth:*—Instruction addressed to the eye, the ear, and the imagination, with a view to furnish a reasonable and healthy recreation to the working classes after the labors of the day. This general scheme necessarily included both sexes within its scope, and hence it was decided to extend all the privileges of the institution to men and women alike. In adopting this general principle, the Trustees were fully aware that it could not all be carried into effect at once, and that the respective divisions, although philosophic in their nature, must necessarily be blended to some extent in their execution. Nor was it felt to be any ground of objection, that the useful and practical should be mingled with the agreeable and recreative.

## QUESTIONS AND ANSWERS.

*Under this head we propose to answer questions sent us, pertaining to our specialty, correctly, and according to common sense methods.*

*Every question, to insure any attention, must invariably be accompanied by the writer's name and address. If so requested, neither name, correct initials, nor location will be published.*

(303) F. J. H., Howell, Mich., asks: What is the torsion on an engine shaft per horse-power? *A.*—It varies in different engines more than 100 per cent., depending on a variety of conditions that must be known before any calculations can be made.

(304) G. A. H., Philadelphia, Pa., asks: Which is the simplest plan for determining the gears for cutting screw threads; simple geared or compounded? *A.*—You will find the whole subject very fully treated in the AMERICAN MACHINIST of August 13 and 20, and October 15, 1881.

(305) Y., Freeport, Ill., writes: I have been dipping iron in acid solution of sulphate of copper, but the copper scales off in places. What is wrong? *A.*—We should judge that the iron is not properly cleaned. Try immersing the articles for ten minutes in water containing about two per cent. muriatic acid, then thoroughly scrub with a wire brush and sand, after which wash in clean water till all traces of acid are removed.

(306) F. A. H., New York, asks: Can you give the pressure, per square inch on projected area of standard railway car axle, when placed under loaded passenger and freight cars, respectively? *A.*—The master car builders' standard axle has a journal 7x3¼ inches, which gives 22.75 square inches of projected area. A loaded passenger car, weighing 45,000 pounds, resting on four axles, will put a pressure of 247 pounds to the square inch. A loaded freight car, of 50,000 pounds will press with a weight of 286 pounds on each inch of axle journal.

(307) W. B. S., Boston, Mass., asks: 1. How would you calculate the area of a piston on the back of a slide valve to satisfactorily balance it? *A.*—A slide valve can be relieved, but not balanced in this way. We should make the area of piston equal to the area of the exhaust cavity or cavities in the valve, *plus* one-half the area of one of the steam ports. 2. Can you recommend a good work or article on fan blowers? *A.*—There in no work devoted to the subject that we know of. You will find articles on the subject in most works on mechanics, none of which are probably very valuable.

(308) F. H., Minneapolis, Minn., says: A friend of mine runs an engine connected with a shop transfer table. In starting, we will say the engine cross-head is on the forward center; he moves a distance of, say, 200 feet and returns to the same spot, when the cross-head is found to be in the middle of the guides. I claim that the engine has slipped, but my friend disputes that. Now, who is right? *A.*—The engine wheels have slipped a little, though the man handling the engine may not have noticed it. There is always more or less slip to wheels running on railroad track. If you start to haul a dead engine with the side rods down, the relative position of the crank pins will change within a few rods.

(309) C. H. M., Philadelphia, Pa., says: After giving a year's trial to a boiler compound, and finding its use unsatisfactory, I took a sheet of zinc 36x20 inches and rolled it into a cylinder 36x4 inches, with open ends. This I suspended within the boiler. Three weeks after putting in the zinc I examined the boiler, and found a light deposit of soft mud on shell and about one quart of sandy deposit [a sample of which was sent to us] in the zinc cylinder. What caused the deposit in the cylinder? *A.*—The deposit consists of carbonate of zinc. The carbonic acid and sulphuric acid, which hold the lime salts in solution in your feed water, having a strong affinity for zinc, desert the lime that carried them into the boiler, just as other fickle things are apt to abandon old friends. The lime then falls down in the form of mud. The zinc also creates galvanic action inside the boiler which tends to prevent scale forming.

(310) G. S. G., Atchinson, Kan., writes: 1. I am running the engine in a foundry. We have a No. 5 blower, running (not accounting for slip of belts) 4,032 revolutions per minute. I have an inverted siphon of glass ⅛″ inside diameter, filled half-full of mercury, one end connected to blast-pipe with ½″ gas-pipe, 4 feet long, all joints tight, the other end open to atmosphere. When the blast is on the mercury stands 2″ higher in the open end than in the other end. In order to settle a dispute, will you please inform me the pressure to the square inch in blast-pipe? *A.*—Two inches of mercury corresponds to a pressure of about one pound per square inch; to be more exact, 98-100 lb. 2. Do you consider this result good? *A.*—It is rather high speed for the fan, and we should suppose the pressure rather higher than would be needed; however, if it is satisfactory, it is probably all right. The pressure at cupola is probably less.

(311) J. W. W., Mount Pleasant, Miss., writes: 1. I am using a 9″x12″ engine, piston speed 300 feet per minute, to drive a 30″ corn mill, requiring 10-horse power, belted direct. The valve has 1-16″ lead, 15-16′ outside lap and 5/8″ inside lap, travel 3⅛″, cuts-off at about ¾ stroke. The exhaust cavity in valve is 6½″ long. The boiler pressure is 60 to 70 lbs, the steam passing through 13 feet of 2½ pipe with five elbows. I send you sketch of valve seat. [The sketch shows ports at each end of the cylinder, the same as when a double valve is used, but in this case, owing to the cylinder being short instead of an exhaust cavity in the valve at each end there is but one cavity, which, as stated, is 6½″ long. The steam ports are 13-16″x7″; exhaust ports 1⅛″x7″.] I want to ask: 1. Are the exhaust ports large enough? *A.*—Yes. 2. I cannot run with 40 lbs of steam. Ought not the engine to furnish 10-horse power with 40 lbs boiler pressure? *A.*—Just about, we should say. 3. The valve laps on the middle bars ¼″. Would it not be advisable to cut that much off [the bars]? *A.*—We can see no reason for doing this. 4. As the outer and inner edges of the valve control the admission and release of steam, what is the use of the middle bar or bridge in cylinder between the two exhaust ports? *A.*—It is not of much consequence, that we can see, but probably does no harm. 5. Are the proportions of valve and seat good; and, if not, what change can be made to get better results? *A.*—The valve seat is badly proportioned, in that it requires the use of a large valve, which takes a good deal of the power of the engine to operate. The lap and travel given by you would cut-off—average of both ends—at less than 5/8 stroke. You cannot do much as the case stands. We should reduce the outside lap to ¾″ and the inside lap to 5-16″. This would of course necessitate moving the eccentric. The steam pipe is too small, if it must have so many elbows. It would be better if 3″. 6. What is the cause of the cross-head wearing all on the bottom, and the rod brasses the most on top? *A.*—It is owing to the direction the engine runs, and to the weight of rod. 7. The boiler is 36″x10 feet, dome 22″x24″. The distance between top row of flues and top of shell is 13, gauge-cocks 2″, 4″, and 6″ above flues. Is there sufficient steam room, with water at second gauge-cock? *A.*—It will do very well. 8. Would any change be required to put in a balance valve? *A.*—You would undoubtedly require a new steam-chest cover; perhaps other changes.

## BUSINESS SPECIALS

***Transient Advertisements, 50 cts. a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Wednesday for the ensuing week's issue.***

Mackenzie Cupolas and Blowers, 245 Broadway, N.Y.

Presses & Dies, Ferracute Mach. Co., Bridgeton, N. J.

Steel Name Stamps, &c. J. B. Roney, Lynn, Mass.

Amateur's Rotary Files. Tower M. W'k's, E. Brookfield, Mass.

For Sale, Cheap—Patent used in cotton mills. Address Box 339, Wakefield, Mass.

Interchangeable work a specialty. Send stamp for new Lathe Catalogue. E. O. Chase, Newark, N.J.

"How to Keep Boilers Clean." A book mailed free, by James E. Hotchkiss, 86 John street, N. Y.

Fine tools and special machinery. Horace Thurston, 84 Clifford street, Providence, R. I.

Herbert W. T. Jenner, Mechanical Engineer and Solicitor of Patents, 632 F st., Washington, D. C.

Lyman's Gear Chart. How to lay out gear teeth. Price 50 cents. E. Lyman, C. E., New Haven, Conn.

Foot Power Machinery, for workshop use, sent on trial if desired. W.F. & John Barnes, Rockford, Ill

The latest Improved Tack and Match Machinery is made by White Machine Co., Waterbury, Conn.

Pattern and Brand Letters. Vanderburgh, Wells & Co., corner Fulton and Dutch streets, New York.

Consulting Engineer and Mechanical expert, C. C. Hill, 84 Market street, Chicago, Ill.

R. Dudgeon, 24 Columbia st., New York, Improved Hydraulic Jacks and Roller Tube Expanders.

National and box chucks, foot and power lathes, and slide rests. Lodge, Barker & Co., Cincinnati, O.

DRAWINGS—Mechanical, electrical and Patent Office. All styles of artistic designing. Special facilities. Low rates. Wallace Metcalf, 140 Nassau St., N.Y.

Guild & Garrison's Steam Pump Works, Brooklyn, N. Y. Steam Pumping Machinery of every description. Send for catalogue.

Improved Tack Machinery, made by The Willets Man'f'g Co., can be seen in operation at their works, 57 Clifford St., Providence, R. I.

The "Wax Process" Engravings shown in the AMERICAN MACHINIST each week are made by Struthers, Servoss & Co., 32 Frankfort Street, N. Y.

Split Pulleys at low prices, and of same strength and Appearance as Whole Pulleys. Yocom & Son's Shafting Works, Drinker St., Philadelphia, Pa.

Engine Lathes, Hand Lathes, and other fine tools. Assortment large: prices low. Frasse & Co., 62 Chatham St., N. Y.

The Complete Practical Machinist, $2 50; the Pattern Maker's Assistant, $2.50; Mechanical Drawing Self-taught, $4 00; books for practical machinists. Address, Joshua Rose, Box 3,306, New York City.

EXTRACTS FROM CHORDAL'S LETTERS, 400 pages, 12mo., handsomely bound in cloth. New and enlarged edition, with over 50 illustrations. Price $2. Published by John Wiley & Sons, 15 Astor place, New York.

For a strictly first-class automatic engine, from 10 to 60-horse power, apply to the Straight-Line Engine Company, Syracuse, N. Y.; medium or high-speed; perfect balance; fewest parts and fewest working joints; uniform speed at all ranges of power or steam pressure; the best material and workmanship in all vital parts; the most correct distribution of iron; unexcelled in smooth running.

## MANUFACTURES.

Joseph & Jacob Clebel, Montgomery, Ala., will a erect carriage factory.

J. G. Dailey, Rome, Ga., contemplates putting up a large furniture factory.

J. T. Critcher & Son, Roxboro, N. C., will erect a buggy and wagon factory.

The foundations are being laid for John Mohr & Sons' new boiler and machine shop, Chicago.

A stock company has been formed which will build a rasp and file factory at North Hanson, Mass.

Machine shops to cost $25,000 will be built this summer at Barnesville, Minn., by the St. Paul, Minneapolis, and Manitoba Railroad.

A. D. Estill and Major Joliffe have rented the foundry of the Lexington Manufacturing Company, Lexington, Va., and will put it in operation right away.

The large building for a foundry and machine shop, at Mitchell, Dak., is nearly completed. About $12,000 worth of iron-working machinery is now on the way.

We learn from the *St. Louis Age of Steel* that the Missouri Malleable Iron Company, of that city, has shut down for two weeks, owing to the slacking up of trade.

Temple, Texas, is about to have a boom in the way of an extensive iron foundry, pattern shop, and boiler yard. Other factories are projected.—*Brenham Banner.*

The *El Paso* (Tex.) *Times* says that the Mexican Central Railroad is taking out all steam pumps along the line and using hand pumps with Mexican labor at 35 cents per day.

S. L. Wharton, Seventeenth street and Susquehanna avenue, Philadelphia, will erect a 15x40-foot addition to his iron foundry.

The most prominent business men of Salisbury, Maryland, are endeavoring to have the machine shops and offices of the New York, Philadelphia, and Norfolk Railroad Company located in that place.

Hugo Tollner, 421 Franklin avenue, Brooklyn, N. Y., will erect an L-shaped brick picture-frame factory on Graham avenue, 40 and 75x30 and 100 feet, three stories high. It will cost about $7,500. Steam power will be used.

Since the opening of its workshops last year, the Canadian Pacific Company has built twenty locomotives. The passenger locomotives are all of one pattern, with 5 feet 9 inch driving wheels, and all painted a dead black.—*Railway Age.*

The Blevney Manufacturing Company, of Newark, N. J., have issued a new illustrated catalogue and price-list, of pulleys, clutches, and couplings. The Blevney friction clutch and chuck pulley have already been illustrated in our columns.

The Tricycle Manufacturing Company, Springfield, O., will have their addition to shop completed and ready for operation about September 1. The building is 48x150 feet. About $10,000 of machinery is being placed in the shop. One hundred and thirty-five men are employed.

The *Roanoke* (Va.) *Leader* says: On last Thursday the first car wheel was cast at the Roanoke Machine Works, under the supervision of Superintendent S. B. Haupt. We learn that it was a perfect success. These wheels have heretofore come from Erie, Pa., but it is the purpose of the management to manufacture them here in the future.

We have received a finely-illustrated and beautifully-printed quarto catalogue of the Whittier Machine Company, of Boston. They manufacture elevators, boilers, engines, and machinery. Each different kind of elevator s illustrated, and reference is made to places where they are in use. There is also a long list of parties using Whittier boilers. The New York office is at 91 Liberty street.

The Pond Engineering Company, of St. Louis, has just issued a new illustrated catalogue and price-list, of improved steam and hydraulic machinery, including steam engines, boilers, furnaces, steam pumps, pumping engines, blowing engines, air-compressors, injectors, feed-water heaters, indicators, gauges, valves, etc. The catalogue has sixty-five pages, and tells what buyers wish to know about each article.

The nail factory now being erected at Lewisburg, Pa., by the Lewisburg Nail Works, will contain fifty machines, and is expected to be completed about the middle of October. The works are situated at the junction of the Lewisburg and Tyrone Division of the Pennsylvania Railroad and the Philadelphia and Reading Railroad. T. H. Croft is president of the company, T. H. Purdy treasurer, and F. M. Purdy secretary.

The Boston *Bulletin* says a party of cotton-mill men at Fall River, Mass., contemplate removing their mill to Hot Springs, Ark. They have machinery which cost over $100,000, embracing 4,500 spindles, 110 looms, an engine of 180-horse power, and other property which they will plant in the valley. Their proposition is to stock the concern, taking $20,000 themselves, and ask that the citizens subscribe $30,000, putting in the whole at $50,000.

The Westinghouse Machine Company, Pittsburgh, Pa., have sent the government of New South Wales a 160-horse power automatic engine, for electric lighting purposes. Among those who have just been supplied with Westinghouse automatic engines are: The Barney & Berry Skate Works, Springfield, Mass., 65-horse power; the Branford, Conn., Lock Company, 65-horse power; H. Ainsworth, Fair Haven, Vt., 80-horse power; Portland, Oregon, Electric Lighting Company, three of 65-horse power each.

The Kilmer Wire-Band Manufacturing Company, Schenectady, N. Y., are erecting a 40x100-foot addition to their ornamental wire-fence factory. They are now running to full capacity, night and day. They make a new style of fence. It consists of Bessemer steel hoop, 1¼″ wide and one-twenty-fourth of an inch thick, from which are punched arrow-shaped pieces used for bale ties. The strip (100 to 400 feet long) is then tempered by their new process, so that it will sustain a tensile strain of over 2,000 pounds.

The Egan Company, of Cincinnati, have brought out a new automatic knife grinder, for grinding all kinds of plane knives, which seems to have met with a very favorable reception. They sold one to C. H. Pries & Co., of Kansas City, Mo., who at once paid for it and wrote: "Although we stipulated, as a precaution, for thirty days' trial if necessary, it did not take thirty minutes to ascertain that the machine was a good one and thoroughly satisfactory. We are well pleased with the machine, and if our name will assist in recommending the knife grinder to others, we cheerfully offer it."

R. E. Masters writes us: Last spring Mr. G. W. Woodruff, proprietor of the Empire Flour Mills, Columbus, Ga., wishing to put in new machinery, visited some of the largest mills in the North in company with a competent miller, to determine what style of machinery they would use. A contract was made with E. P. Allis & Co., Milwaukee, Wis., to put in an engine and new machinery throughout. The mill started up on the 17th inst. The engine is a Reynolds-Corliss, having a 20″x48″ cylinder, fly-wheel 16 feet diameter, 24″ face, weighing 22,000 lbs. Engine guaranteed at 250-horse power, and under 70 lbs. pressure it runs the machinery at work with ease. The machinery is the foot-roller system, both iron and porcelain rollers being used. Grain is taken direct from cars to bins, thence to mill by conveyors and elevators. Capacity of mill 500 bbls. of flour and 2,000 bus. of cornmeal and hominy per day. Cost of improvements $55,000.

The *Morning News*, of Wilmington, Del., says: The new cable railway at the stone quarries of Andrews & Locke on the north side of the Brandywine, above Riddle's mills, gives great satisfaction. Its length is 750 feet, just the same as that of the new B. & P. railroad bridge, and the cable, which is composed of steel wires, is two inches thick. The velocipede car is quite different, the new invention avoiding the clamping and the old system of raising and lowering the car to take on its loads. The present one has a friction engine of 50-horse power, with two drums. Over one runs a wire rope which passes to the south side, where it runs over a sheave, and returns to the forward end of the car, while the other end is attached to the hinder part, thus making an endless wire by which the car is propelled back and forth. Around the other drum runs a wire rope by which the car is lowered to the ground to load or unload, or raised by a single hand upon a lever. The engine, which weighs 25,000 pounds, was made by the Lidgerwood Manufacturing Company, of New York, and is a fine piece of mechanism. The improved car is Colonel Locke's own device. It is able to make the trip in twenty seconds, moving much more rapidly than the one at the bridge.

The Burden Iron Works, Troy, N. Y., are laying the foundation for a 160x45-foot building for the horse-shoe department. It is to be finished within thirty days.

### Machinists' Supplies and Iron.

New York, July 24, 1884.

Indications are that the machinist supply trade is improving although the advance in activity is not much to brag about.

Steam supplies are decidedly better than they were a month ago, and a very hopeful tone prevails among those who handle this kind of goods.

Boiler sheets continue to be very dull, with no indication of immediate improvement.

Iron—There is no notable change in the market for American pig. The same conservative spirit continues among producers and consumers, with the result that the supply is carefully regulated to meet the demand. All parties are hopeful that an improvement will intervene in the near future, but in the meantime prices incline to favor buyers. We quote No. 1 X Foundry $20, for standard brands, but in several instances lower prices have been accepted. No. 2 X Foundry, $18 to $19; Grey Forge, $16 to $17.

Scotch pig is dull, with prices irregular. We quote Shotts, $21.50 to $21.75, to arrive; Coltness, $21.50 to arrive, $22 yard; Glengarnock, $20 50 to arrive, $21.50 yard; Gartsherrie, $21.50 to $22; Eglinton, $19.50; Dalmellington, $19.50.

Antimony—The demand for regulrs continues light, with full supply and prices ruling in buyers' favor. Sellers quote Hallett's 10¾c., Cookson's 10¾c., but purchases have been made at lower figures.

Copper—There has been no change in the market for ingot. Small sales of Lake have been reported at 14c., other brands 13c. to 13¼c.

Lead—The market for common pig has ruled dull. Light sales have been made at 3.60c., but sellers have been found taking 3.55c.

Tin—The market has ruled quiet and about steady. For jobbing lots we quote Banca, 20¾c.; Straits and Malacca, 18¾c.

## ✻WANTED✻

*"Situation and Help" Advertisements, 30 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Wednesday morning for the ensuing week's issue.*

Situation wanted, by a practical brass moulder. Address "Moulder," care of Am. Machinist.

Mechanical draughtsman, of sober habits and varied experience, wants position. Address B., American Machinist.

Wanted—A foreman for a machine shop, in New England, employing twenty hands making fine machinery. Address A. B. C., Am. Machinist, stating experience and salary expected, with references.

First-class mechanical engineer and draughtsman, with extensive experience as designer, superintendent, and salesman, is open to an engagement. Steam engineering a specialty. Best of references. Address "M, 100," Am. Machinist.

Wanted—Young man as foreman of foundry. Must thoroughly understand the business and be a close manager. Light work. One who understands machine moulding necessary. Address "Foreman Moulder," office of Am. Machinist.

A competent and experienced superintendent or foreman desires engagement; used to handling men and the designing of machinery. Best of references from standard firms. Address Box 7, Am. Machinist.

Wanted—Parties traveling and selling to steam users, or dealing in mill supplies, to take the agency of a good and fast-selling article. Good inducements offered. Address "Manufacturer," care of Am. Machinist.

To Draughtsmen, Engineers, etc.—A complete set of detail working drawings of a horizontal steam engine cylinder 10″x18″, of the most modern construction, with double-ported balanced valve and adjustable main bearing. For price and particulars, address I. K. MacKenzie, 1831 Carpenter street, Philadelphia, Pa.


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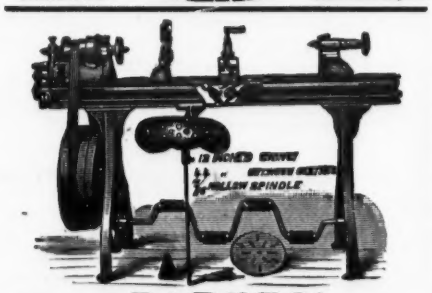

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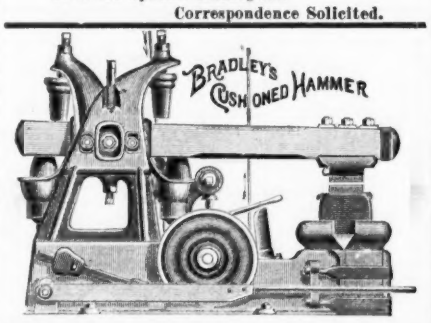


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Tables of the principal speeds occurring in mechanical engineering, expressed in mètres in a second. By P. Keerayeff. Translated by Sergius Kern. Price, 20 cents. Descriptive catalogue of books, 100 pages, free.

E. & F. N. SPON, 35 Murray Street, N. Y.

NEW No. 224 MILL STREET.

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CYLINDERS

Use FIREPROOF and INDESTRUCTIBLE

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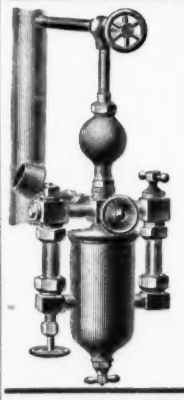

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*Of Every Description, at Reasonable Prices.*

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Special Tools for all purposes for RAILWAY REPAIR SHOPS

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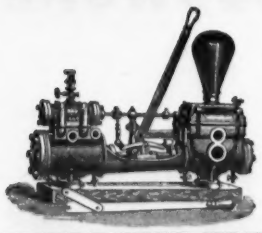

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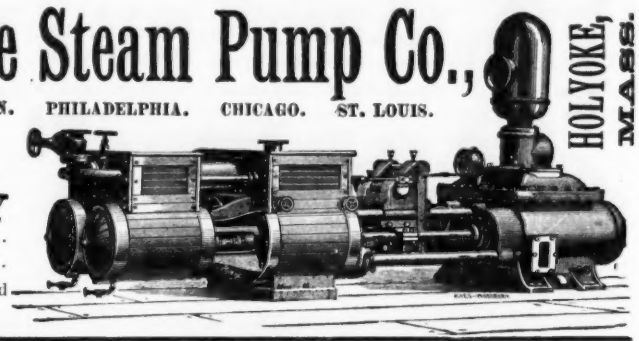

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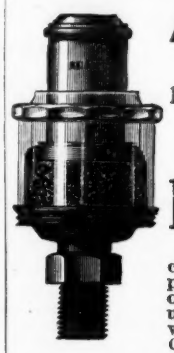

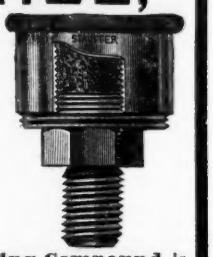

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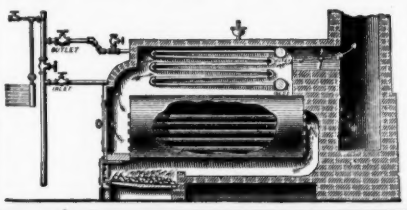

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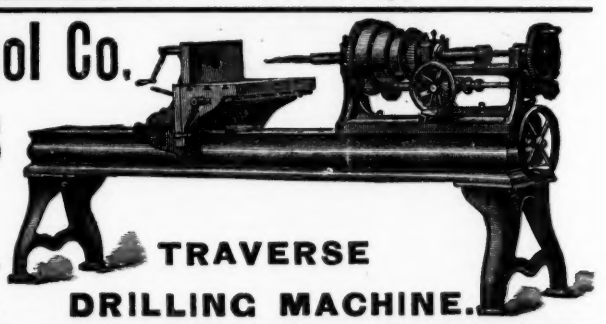

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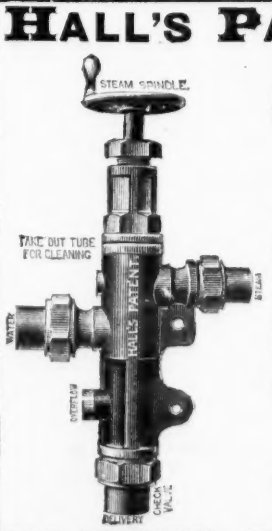


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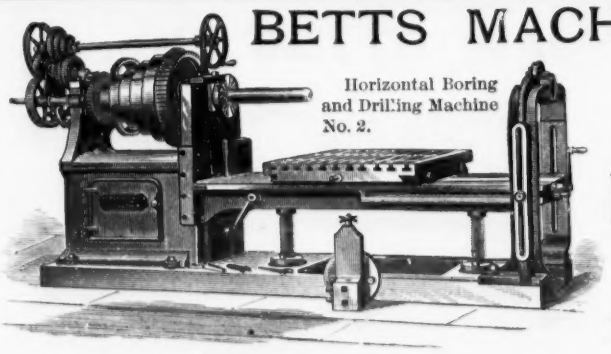

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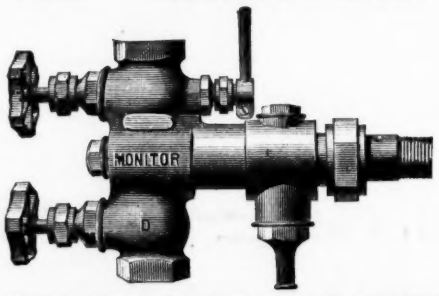


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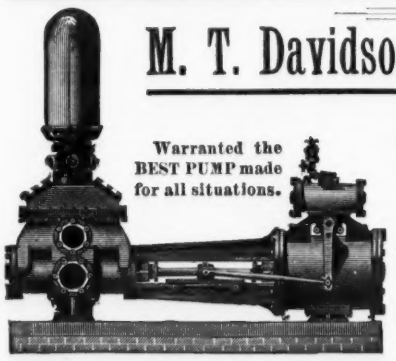

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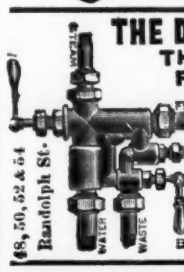


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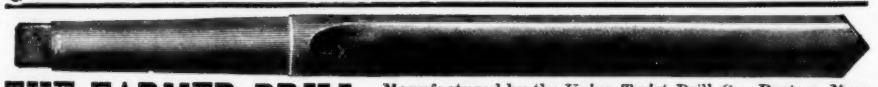

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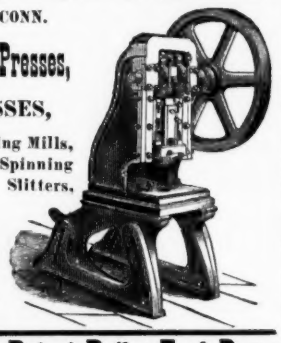

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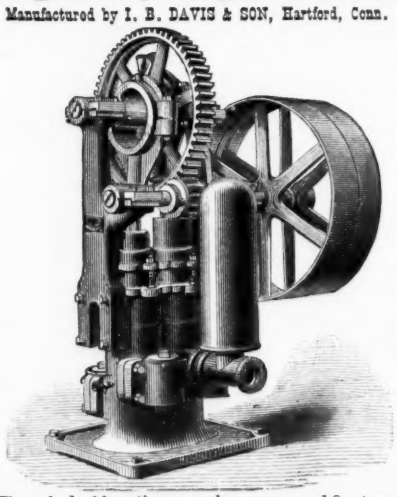

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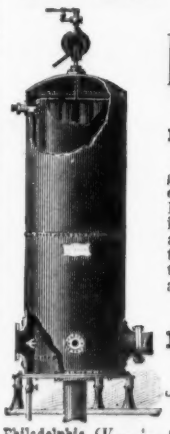

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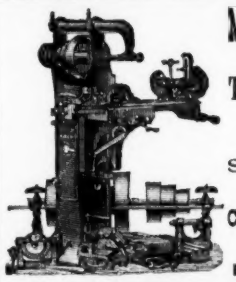

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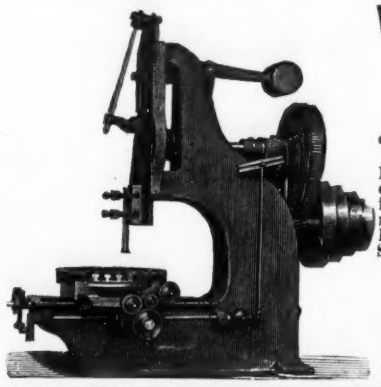

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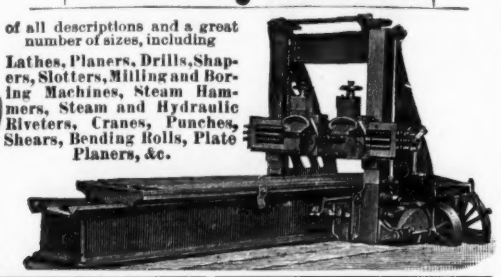

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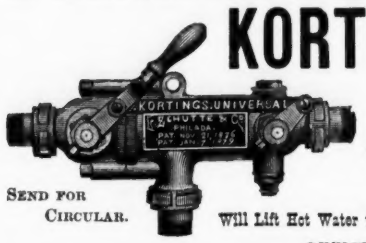


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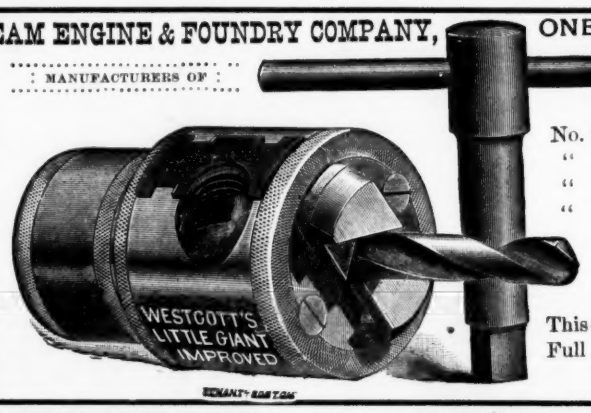


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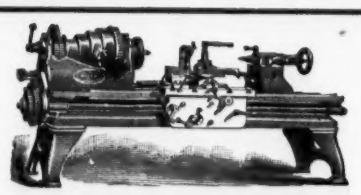

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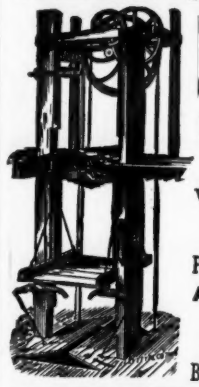

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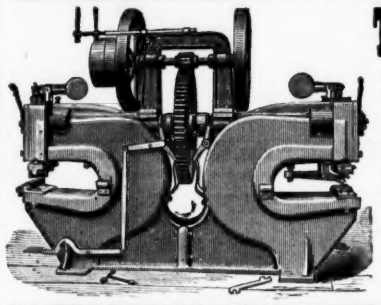

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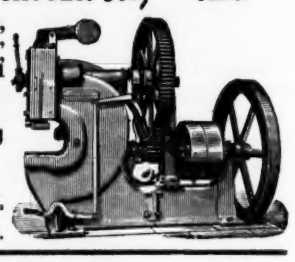

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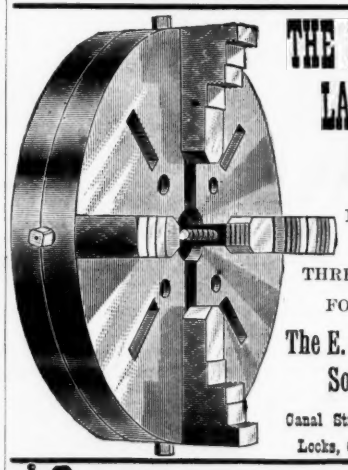

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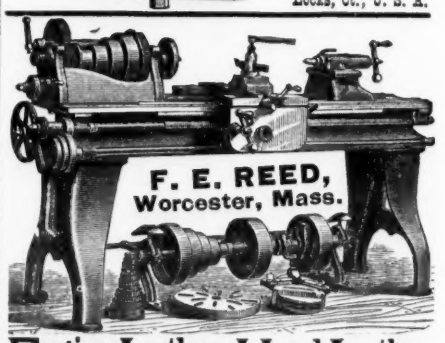

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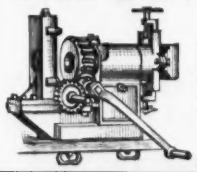

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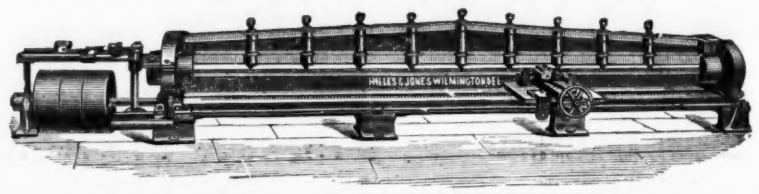


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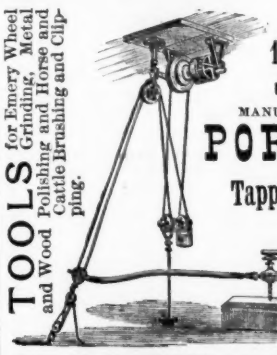

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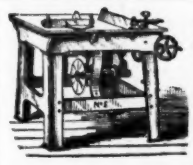

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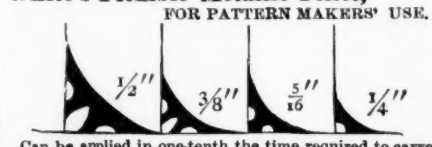


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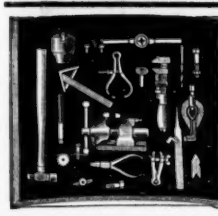

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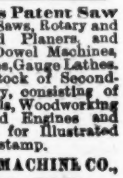

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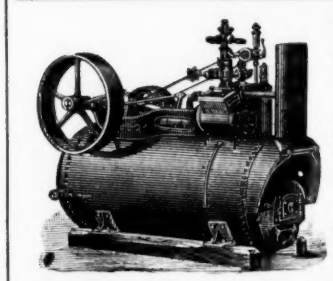

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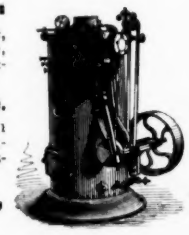

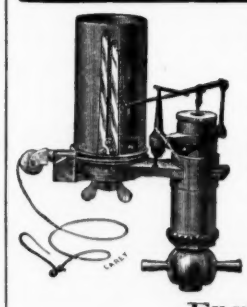

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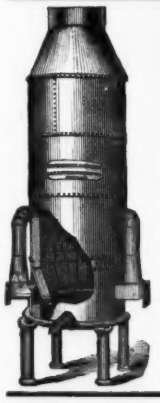

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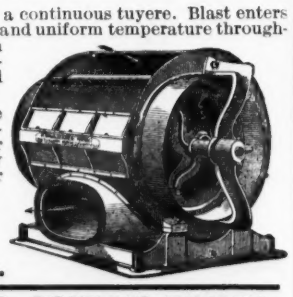

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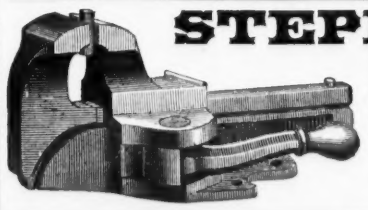

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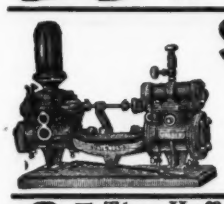

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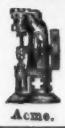

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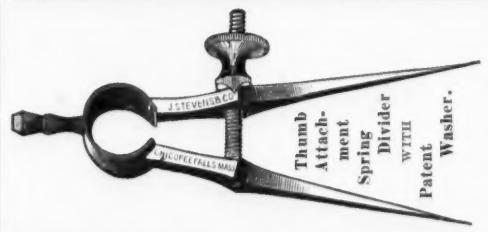


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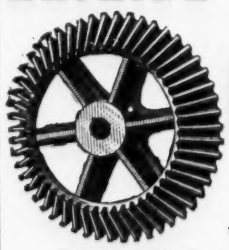

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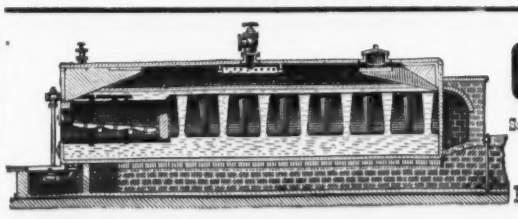

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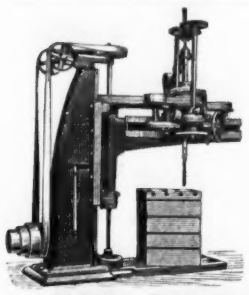

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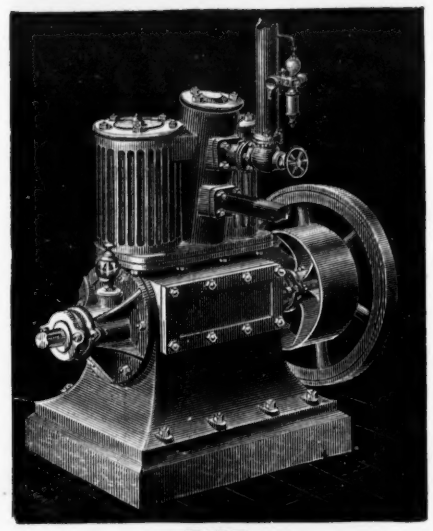

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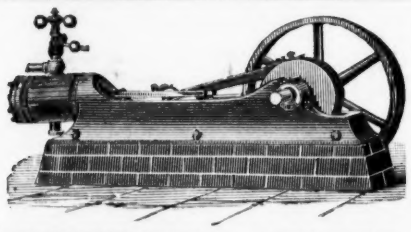

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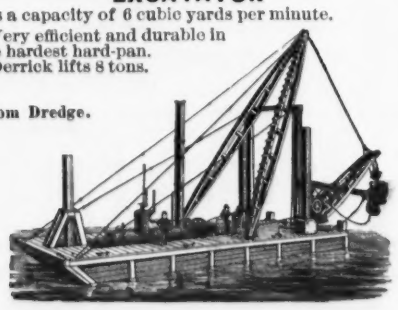

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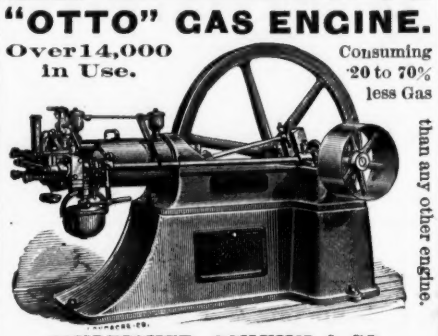

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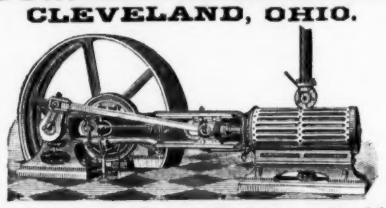

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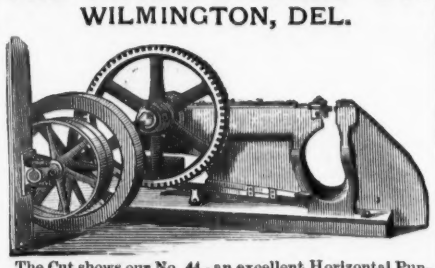

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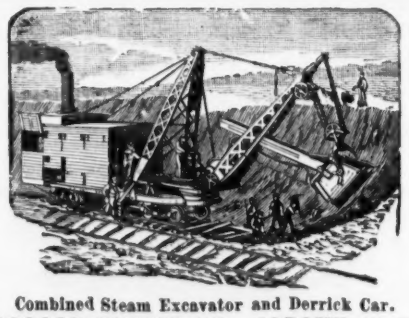

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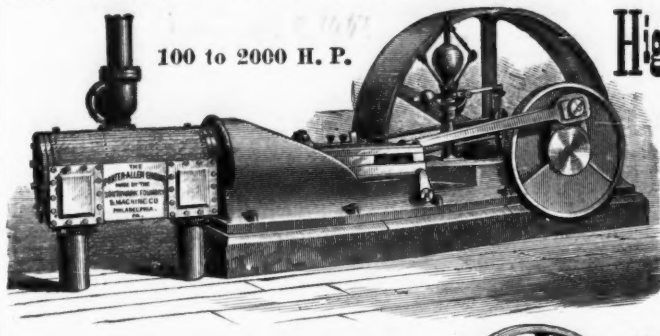

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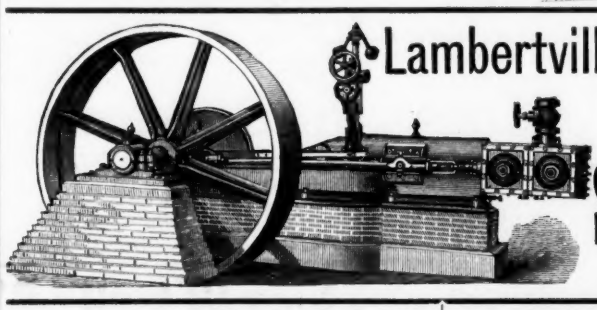

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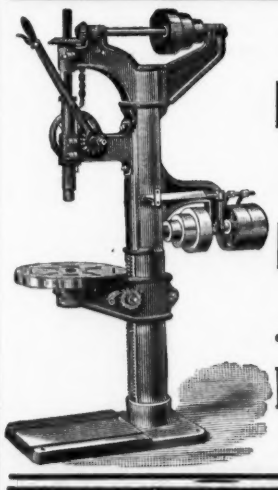

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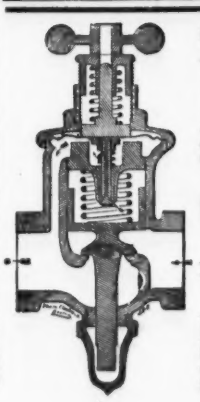

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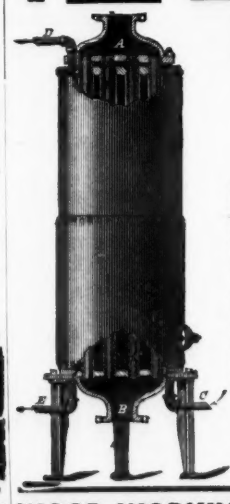

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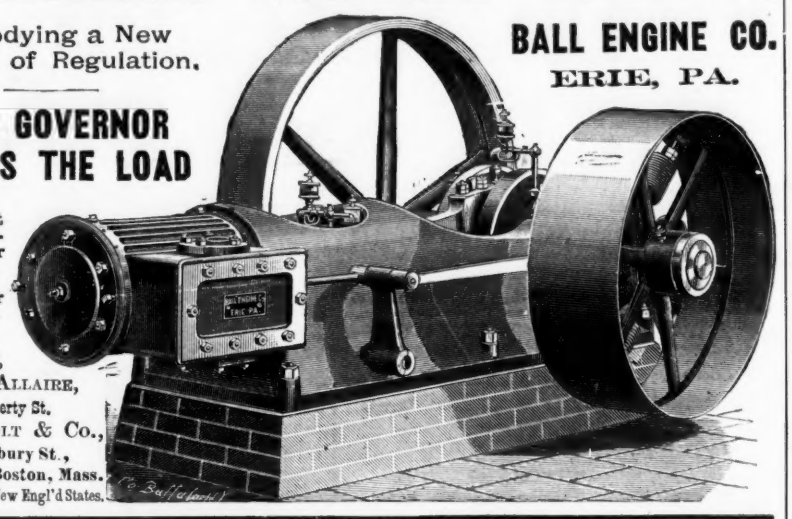

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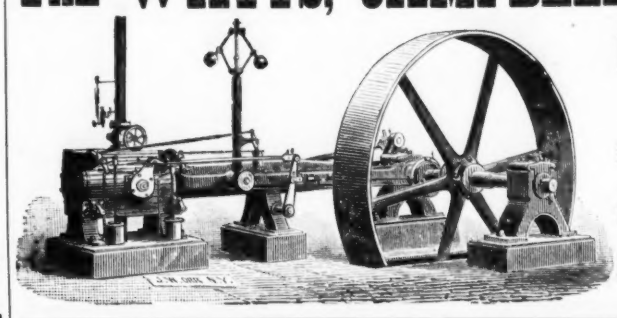

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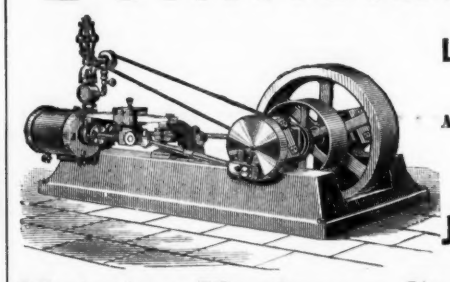

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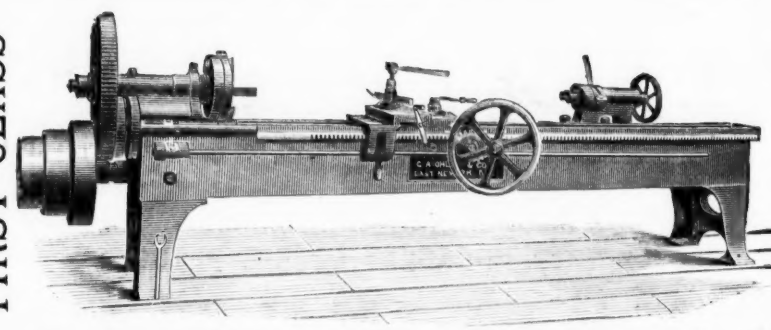

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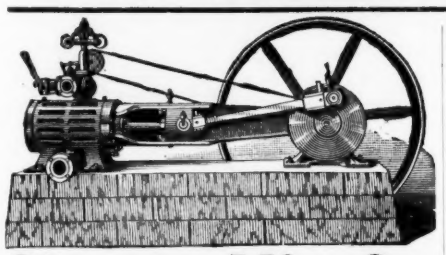

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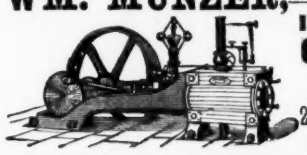

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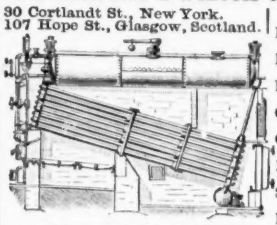

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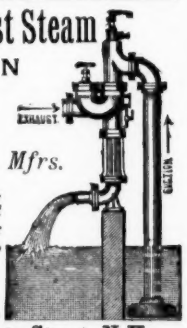


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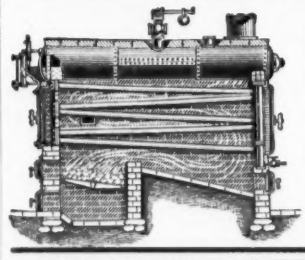

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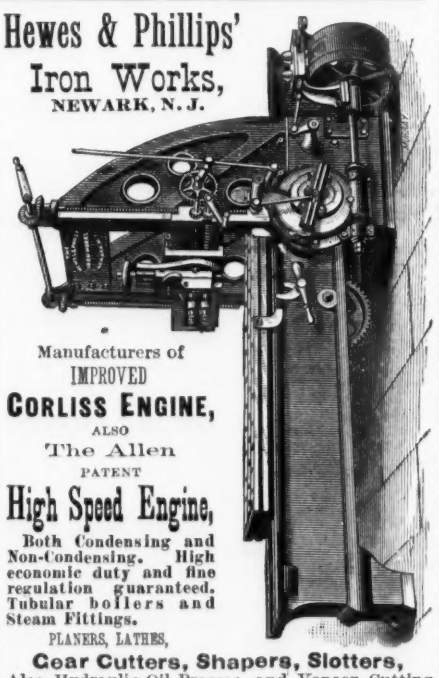

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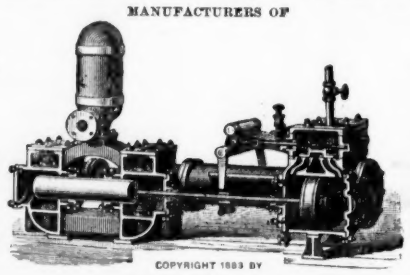


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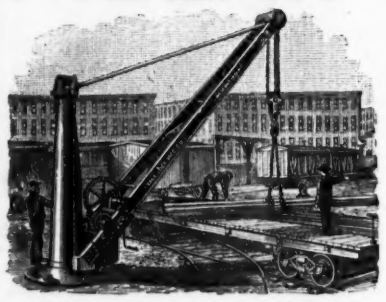

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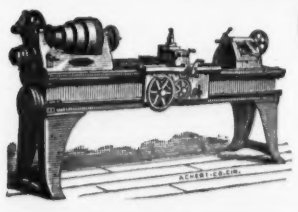

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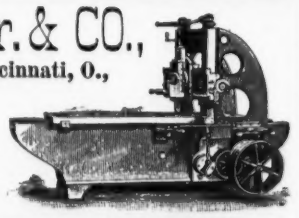

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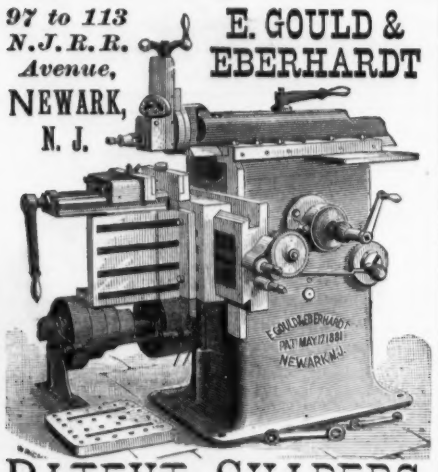


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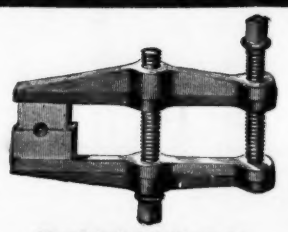

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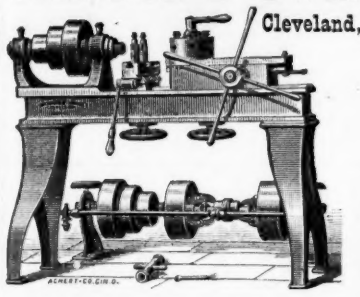

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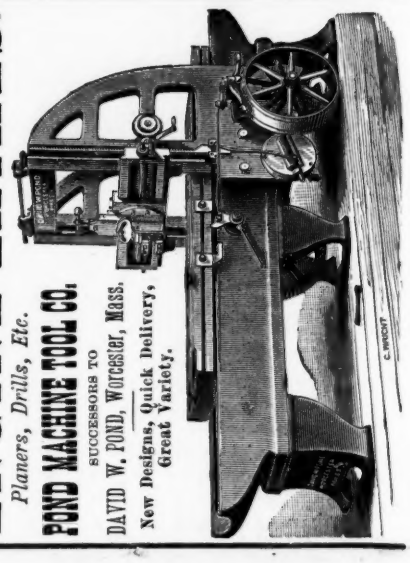

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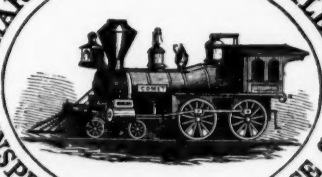

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